AMERICAN SOCIETY OF CIVIL ENGINEERS.
INSTITUTED 1852.

TRANSACTIONS.

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333.
(Vol. XV.—May, 1886.)

THERMOMETER SCALES.

By FRED BROOKS, M. Am. Soc. C. E.

READ MARCH 3D, 1886.

Recent events make it desirable to give a little thought to the difference in the scales used to indicate temperature. It is well known that the scale in popular use in the United States marks the temperature of melting ice 32 degrees, and that of boiling water 212 degrees; while the scale of scientific men marks those temperatures 0 degrees and 100 degrees respectively. If engineering is a scientific profession, engineers may be expected to prefer the latter scale; but they actually use the former the most. The division of the interval between the fixed points into 100 parts has a superiority over that into 180, if there is any advantage in decimal reckoning. Those remarkable numbers, 212 and 32, have no peculiar thermometric virtue. It is unnecessary to draw a lengthy contrast between the two scales as to intrinsic merit. Charles T. Porter's standard "Treatise on the Richards' Steam Engine Indicator," says (p. 39 of third edition) "that the Fahrenheit scale begins in a blunder and ends nowhere." "If the Fahrenheit scale could be at once abolished, and the centigrade scale substituted in its place, we should

be rid of an arbitrary nuisance, which is already being banished from the domain of science, and is a real impediment to popular scientific advancement." This sentence suggests inquiry as to what hinders the desired substitution. The Fahrenheit scale cannot be instantaneously driven out of popular use; yet engineers, as they have occasionally to express temperatures, can do it in centigrade degrees, even though in some cases the equivalent Fahrenheit should be added in explanation. Will there ever be a better time than the present for taking this partial step toward the proposed change? Certainly this course is free from obstacles that sometimes stand in the way of similar improvements. For instance, it is regarded as an indispensable preliminary to such changes, to circulate abundant information in advance, and to provide conversion tables, double scales or diagrams. Well, for thermometers that is already done; the books that engineers use are full of tables and formulas for translating from one scale to another. Again, men do not buy and sell by the degree of temperature; but the thermometer is a scientific instrument, used mostly by intelligent people. There is not in this case that mass of ignorance to be instructed which there would be in the case of things like time-reckoning or coinage, with which everybody has to do.

National prejudices, though utterly irrelevant, too often interfere, as was noticeable in the recent adoption of a common prime-meridian. Happily, American views of the change now under discussion, cannot be distorted by such prejudices with regard to the countries where these thermometer scales originated—for Holland was the residence of Fahrenheit, who produced one of them in 1720; and Sweden, of Celsius, who devised the other in 1742. With those two countries we have the same grounds of sympathy. Sir Isaac Newton published in 1701 some results he obtained with a linseed-oil thermometer (see Philosophical Transactions No. 270, vii, which is at pp. 824–9 in Vol. 22); and Réaumur, the French naturalist, invented in 1731 a spirit thermometer with the scale which was used for many years in France and elsewhere. They both took 0 degrees to designate the temperature of melting ice, though they designated the boiling point differently from each other, and from either Celsius or Fahrenheit. Most branches of measurement are so connected, that a change cannot be made in one thing without some disturbance of others; thus time is related to angular measure, and coinage to weight. But temperature is independent; it has as little to do with one weight

or measure as with another, and people who differ widely in their preferences for a basis of weights and measures should be able to agree upon a thermometric scale. The centigrade scale is used in the meteorological service of Russia, a country which has for length measures the archine and the British foot; of Denmark, which has for length measures the alen and the Rhineland foot; and of the other continental countries of Europe, which have still another length measure. It is also used in places of such minor national rank as the Khedival Observatory in Egypt, and the National Observatory of Mexico. In England, the latest annual report, dated 27th July, 1885, from the Standards' Department of the Board of Trade, drew attention (p. 2) to the fact that various instruments, among which are thermometers, are not directly provided for by the Weights and Measures Act, so that at present the Standards' Department has no power to provide standards for them. So the Briton is not prevented by the law from using such a thermometer as he pleases; and the August, 1885, edition of the British Pharmacopœia, an official publication, contains centigrade temperatures throughout, in addition to Fahrenheit temperatures, which alone appeared in former editions. Likewise in the last decennial revision of the United States Pharmacopœia, published in 1882, both were inserted. The 309th paragraph of the "Revised Regulations for the Government of the Marine Hospital Service," approved 24th April, 1885, and authorized by Supervising Surgeon-General Hamilton, Secretary Manning and President Cleveland, is as follows:

"In recording thermometric observations, medical officers and acting assistant-surgeons of the Marine Hospital Service will make use of and refer to the centigrade scale only."

The United States will be among the last of the nations of high civilization to join in the use of the centigrade scale, even if she brings it into use with the utmost possible rapidity.

The subject of thermometer scales concerns engineers as well as other people, and in that respect resembles standard time, in which this Society has taken a very active interest; but there is the following difference: The centigrade scale can be used in engineering reports, experiments, etc., whenever they are made, be it sooner or later; no date for its adoption need be fixed in advance, as was required for simultaneously setting clocks and watches to the standard time.

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(Vol. XV.—May, 1886.)

THE STEAMSHIP AMERICA.

By ROBERT GORDON, M. Am. Soc. C. E.

READ JUNE 13TH, 1884.

This steamer was built by Messrs. I. & G. Thomson, of Clydebank, and was designed to form a new departure in transatlantic communication. The National Steamship Company, of Liverpool, has long been known for its safe, but somewhat slow, freight-carrying vessels, which have often been selected by the British Government for the transport of troops. The Company, profiting by the results of its own experience and a study of that of rival lines, came to the conclusion that it is necessary to separate fast passenger transport from that of freight in ocean ships, very much as is now done on railways, and determined to try a class of vessels which should be able to steam through the water at a rate of 18 or 19 knots per hour continuously through a long voyage. The aim was to insure a maximum of commodious passenger space and of speed, with a minimum of coal expenditure and of port dues.

These results have been so far attained, that the steamship America proved herself on her first voyage from Liverpool to New York and back, one of the fastest vessels afloat; and, for her capacity, one of the most economical in the use of coal. She was able to maintain a speed

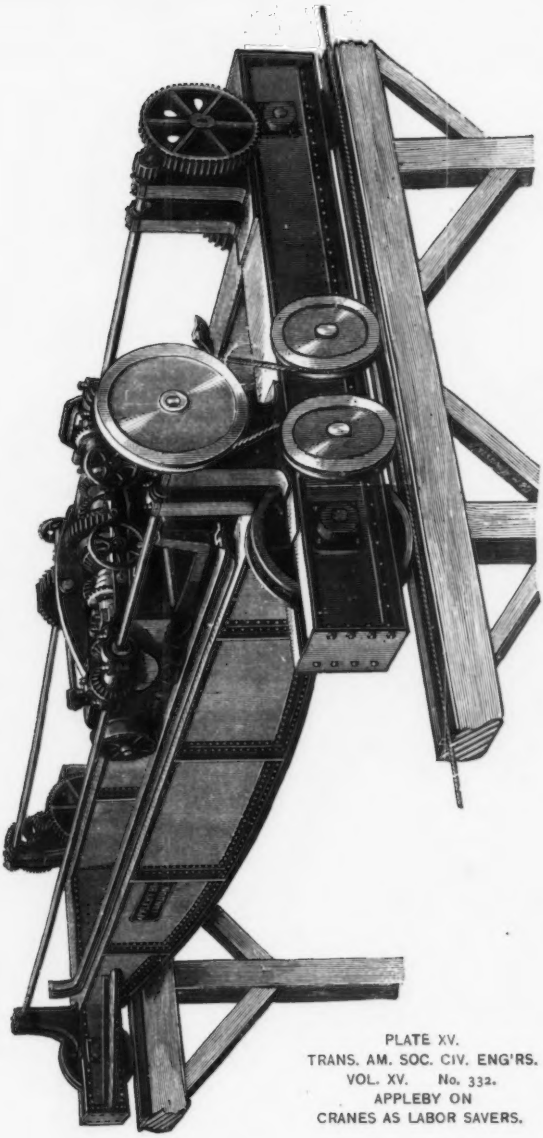
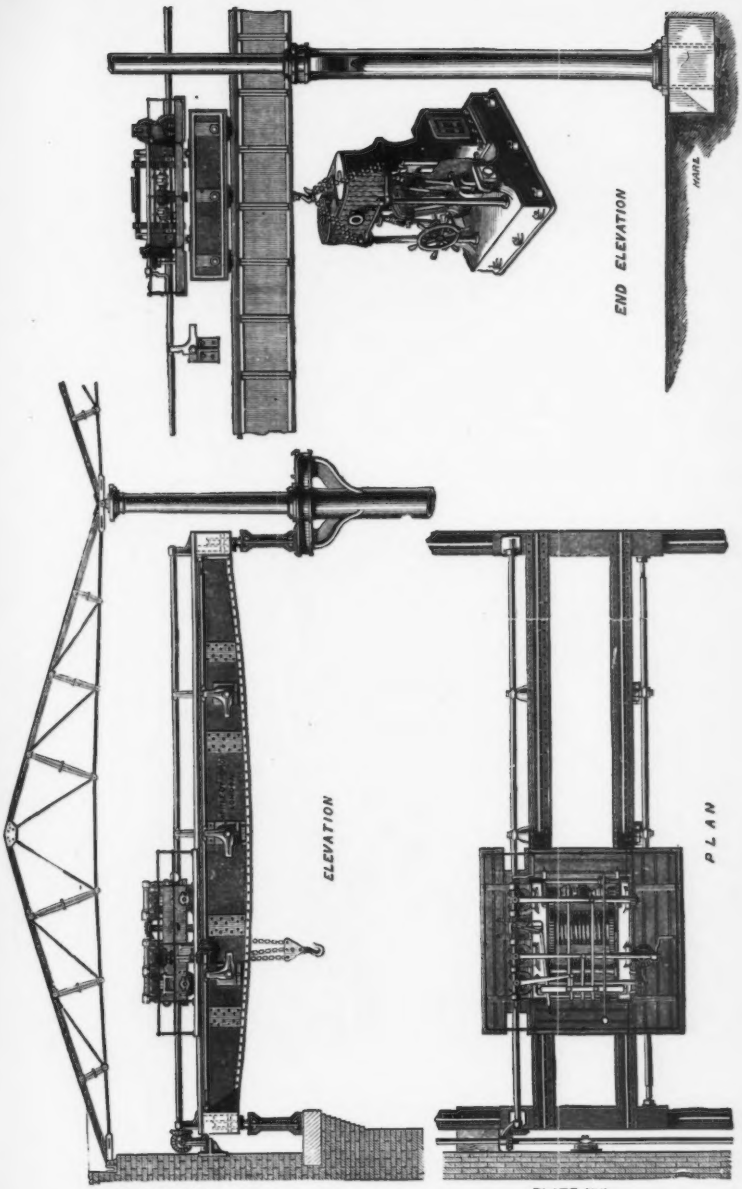


PLATE XV.
TRANS. AM. SOC. CIV. ENG'RS.
VOL. XV. No. 332.
APPLEBY ON
CRANES AS LABOR SAVERS.



APPLEBY ON
CRANES AS LABOR SAVERS.

PLATE XVI.
TRANS. AM. SOC. CIV. ENG'RS.
VOL. XV. No. 332.

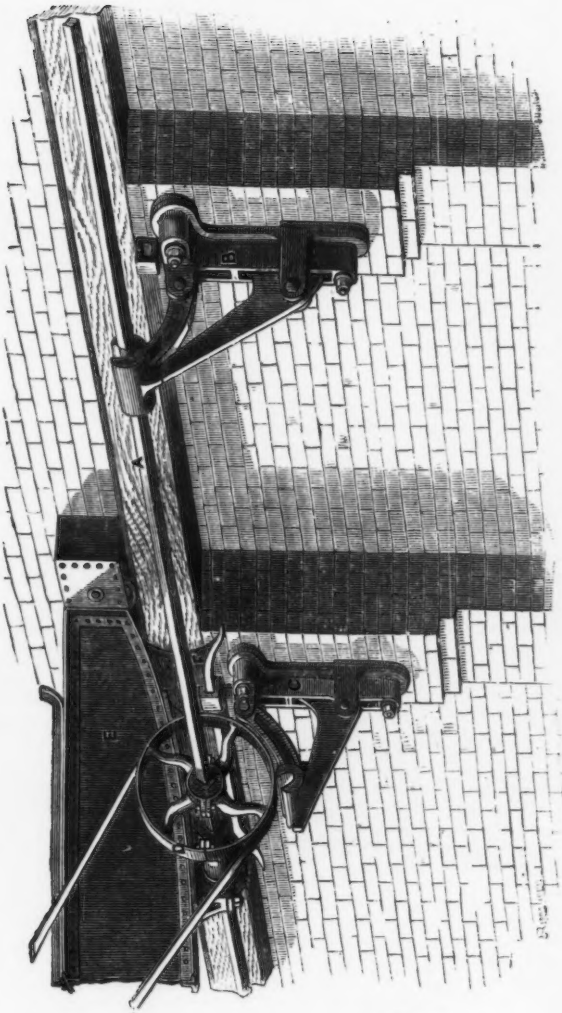


PLATE XVII.
TRANS. AM. SOC. CIV. ENG'RS.
VOL. XV. No. 332.
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CRANES AS LABOR SAVERS.

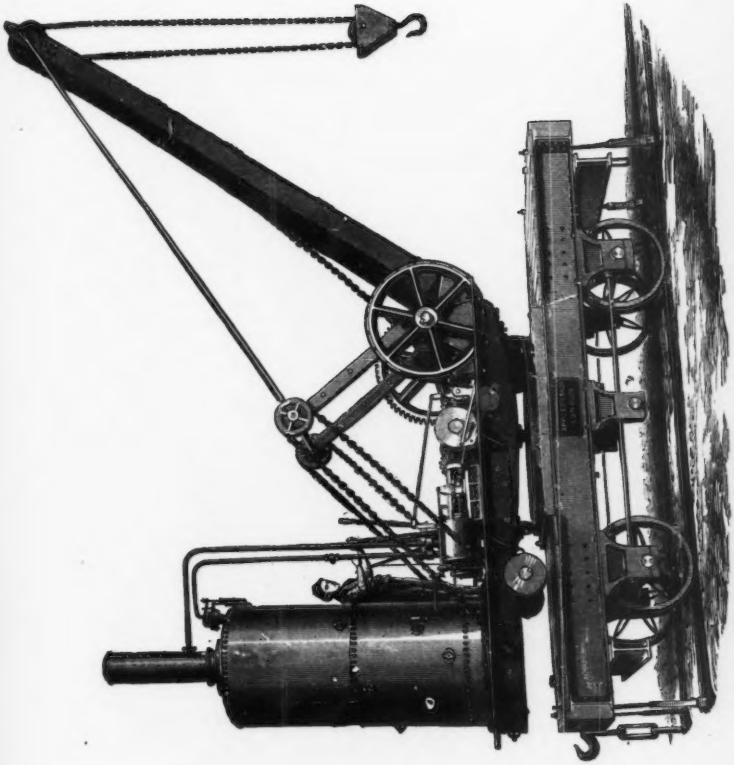

PLATE XVIII.
TRANS. AM. SOC. CIV. ENG'RS.
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CRANES AS LABOR SAVERS.

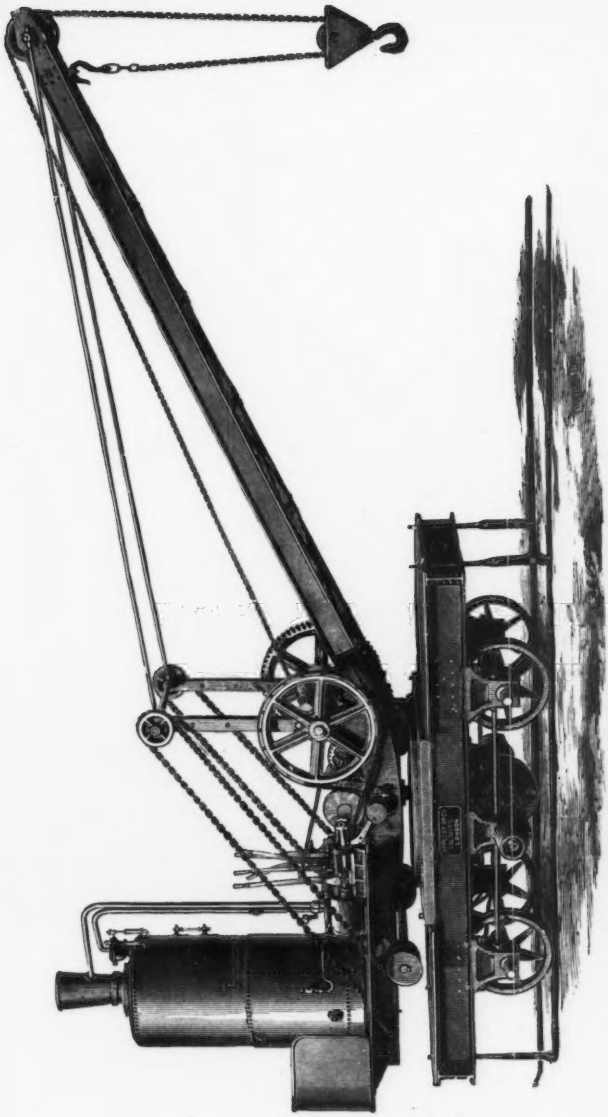

PLATE XIX.
TRANS. AM. SOC. CIV. ENG'RS.
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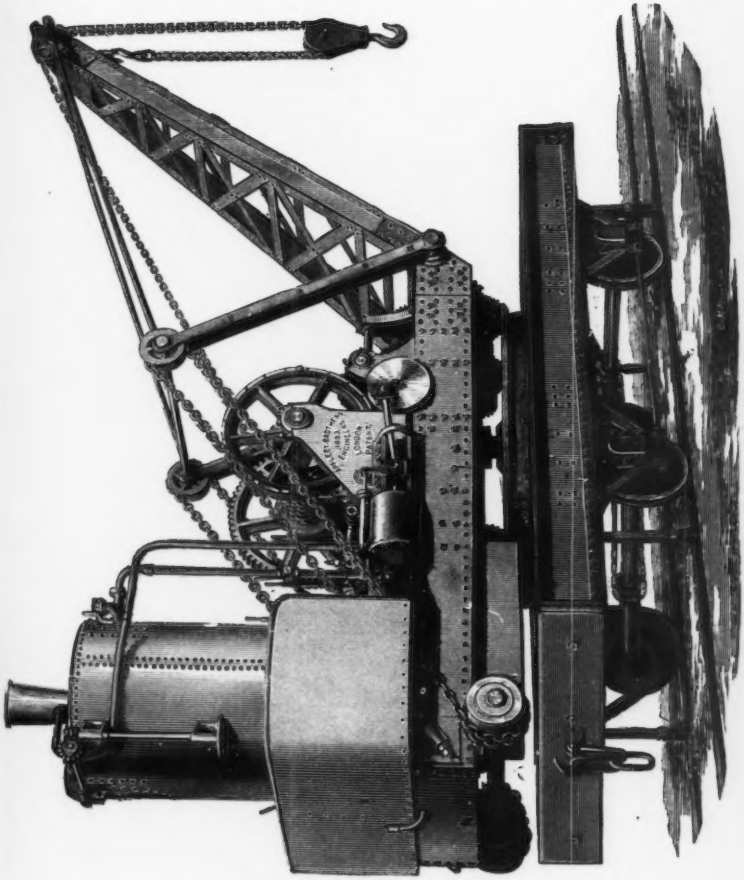

PLATE XX.
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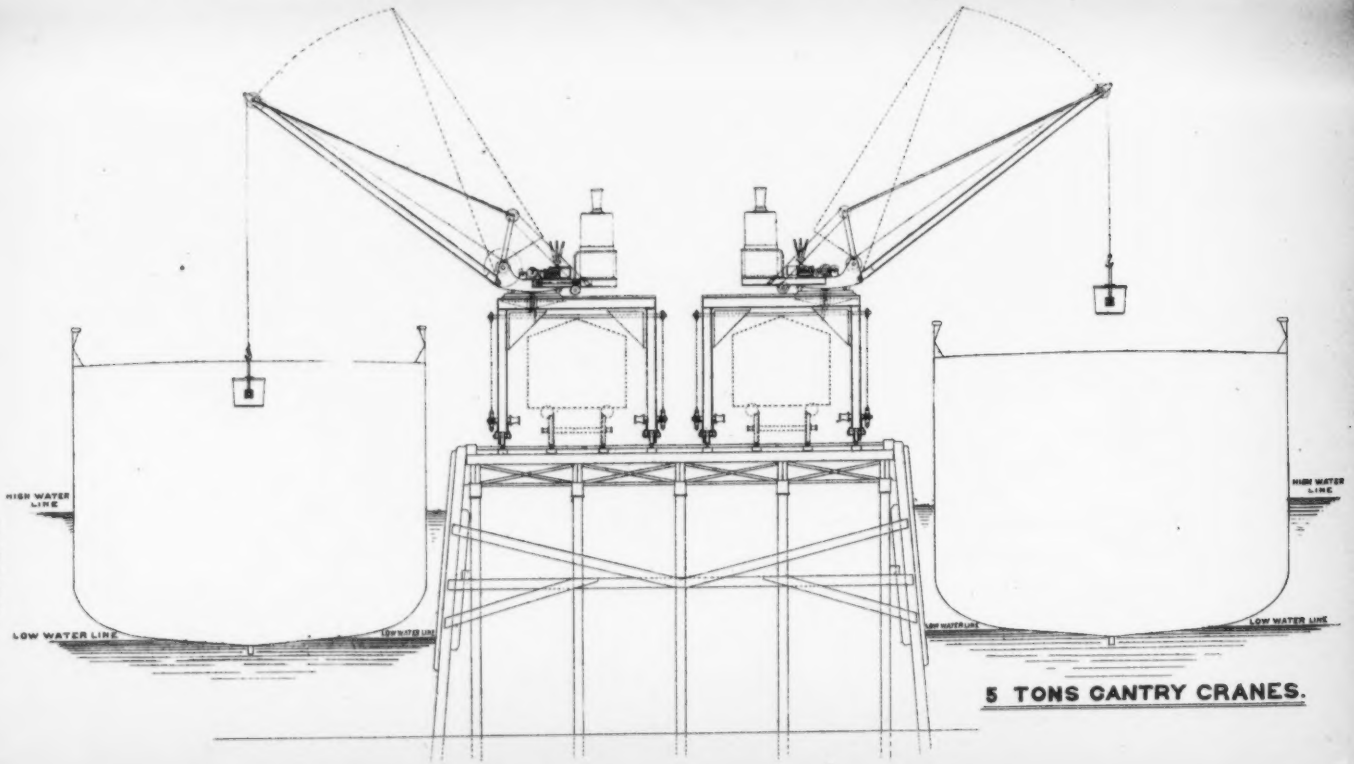
CRANES AS LABOR SAVERS.



5 TONS CANTRY CRANES.

PLATE XXI.
TRANS. AM. SOC. CIV. ENG'RS.
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CRANES AS LABOR SAVERS.

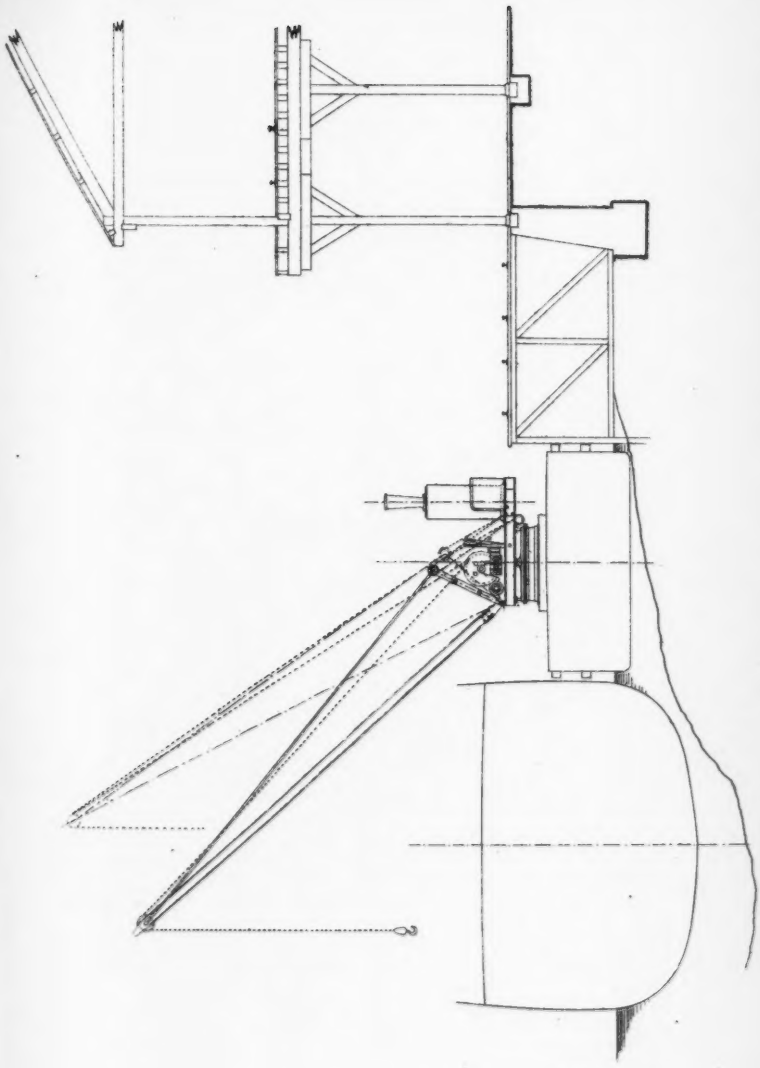
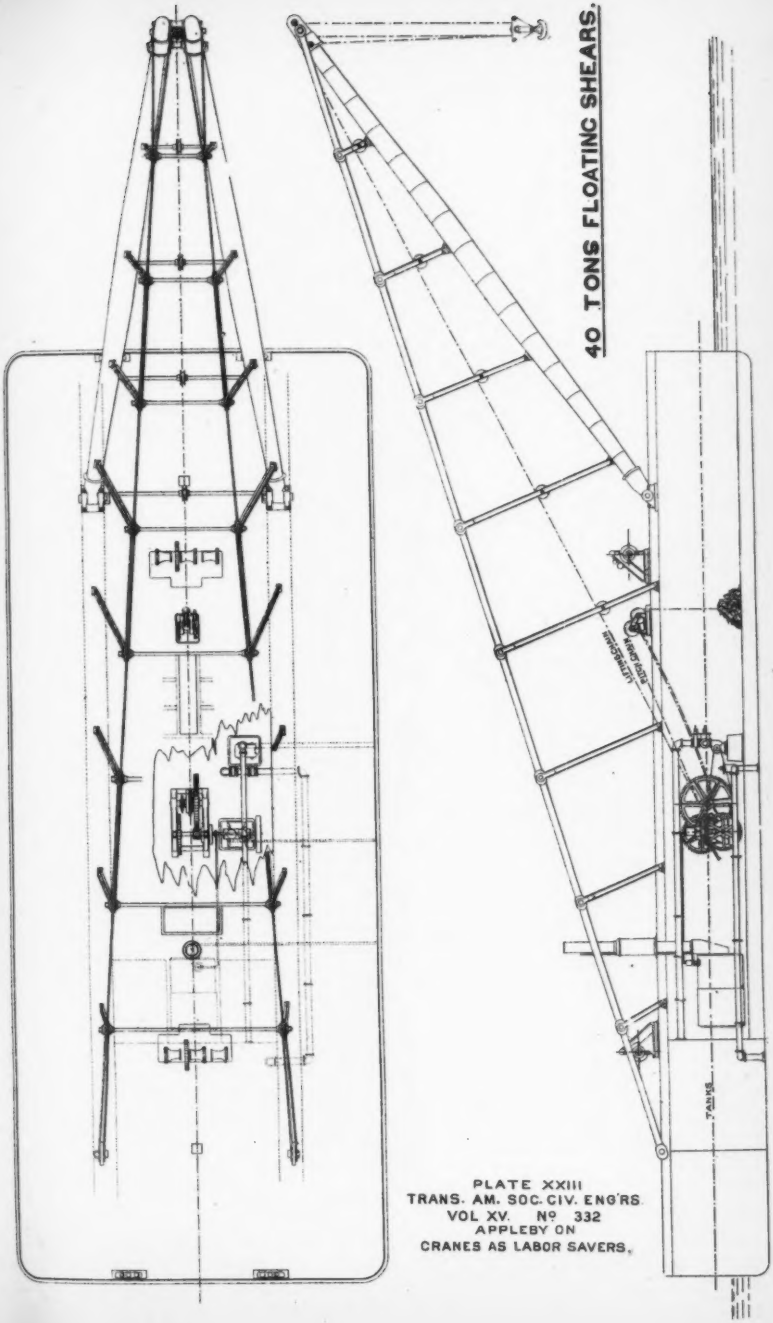


PLATE XXII.
TRANS. AM. SOC. CIV. ENG'RS.
VOL XV. Nº 332
APPLEBY ON
CRANES AS LABOR SAVERS.



40 TONS FLOATING SHEARS.

PLATE XXIII
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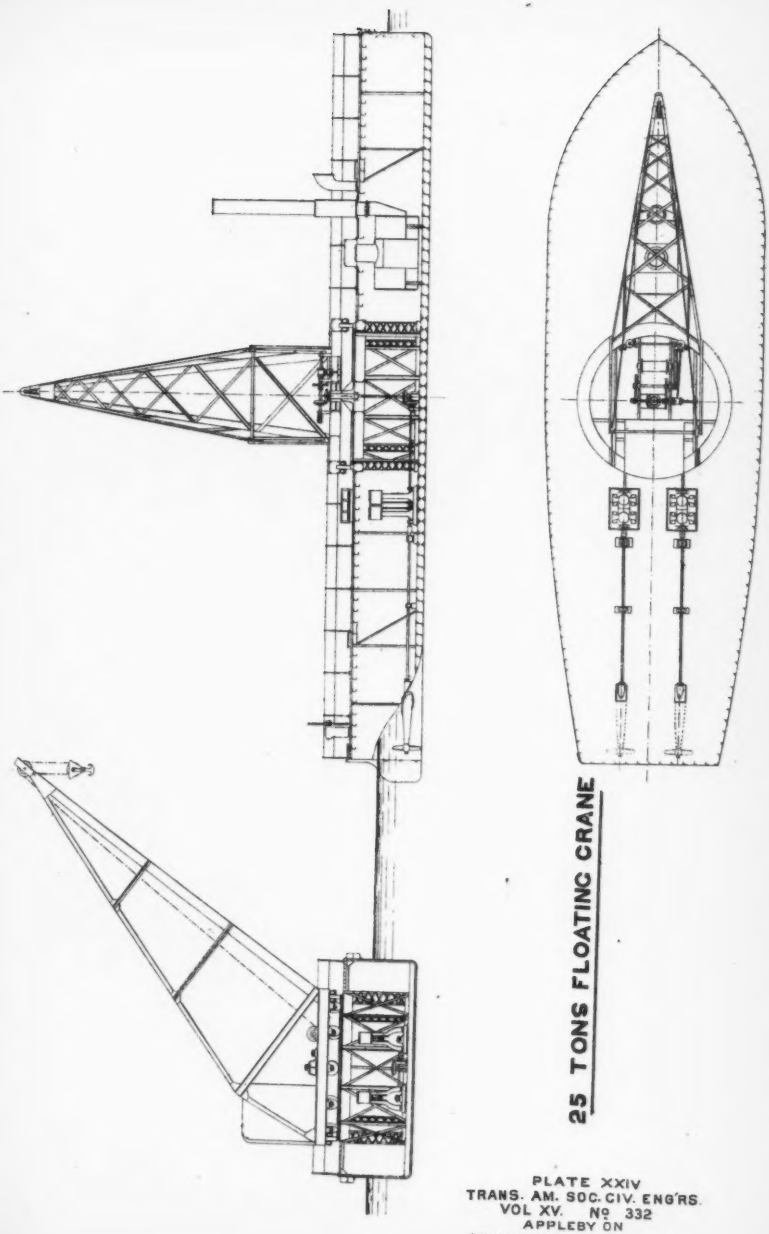
CRANES AS LABOR SAVERS.



25 TONS FLOATING CRANE

PLATE XXIV
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CRANES AS LABOR SAVERS.

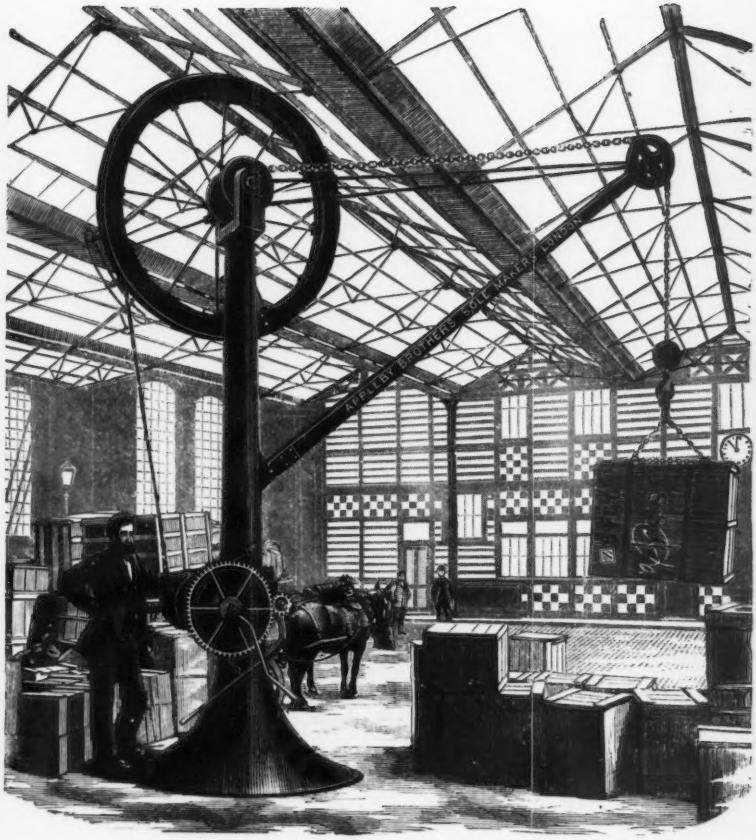

PLATE XXV
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CRANES AS LABOR-SAVERS.

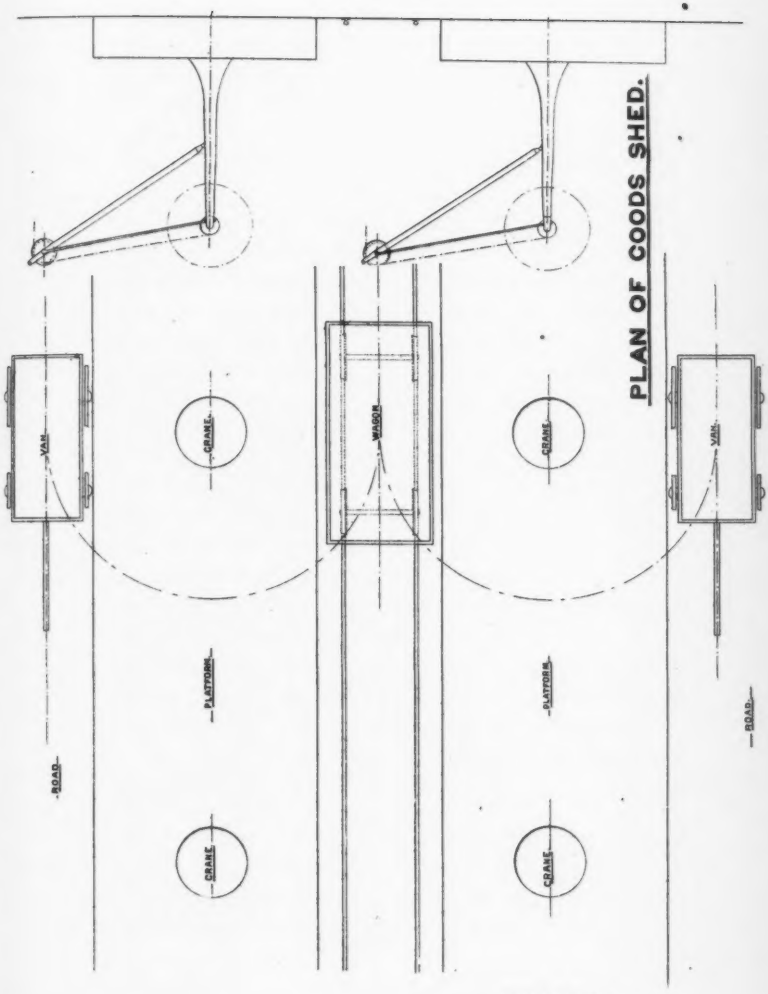

PLATE XXVI
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CRANES AS LABOR SAVERS.

of over 19 knots per hour continuously for many hours, while burning only 180 to 190 tons of coal per day; while other large vessels burn 300 to 340 tons per day without reaching that speed. A short notice of the principal factors in her design, on which these results depend, may be of some interest, and is respectfully offered to the Society, with the kind permission of her builders and owners.*

In the shape of her hull, the America is the embodiment of principles discovered by the late Mr. W. Froude, who, while experimenting on differently shaped models of ships, found, contrary to the expectation and practice of naval architects, that a comparatively short and broad ship, with fairly fine entrance and exceedingly fine run aft, carried on continuously curving lines throughout, could be driven through the water at a higher rate of speed with a less expenditure of power than a long and narrow ship of the same capacity with fine entrance and parallel-sided body. Probably the greater amount of skin friction in the latter vessel might account for this result, but the relation of the resistances arising from this, and from the generation of waves in deep water, to the shape of the ship at different speeds, still requires some elucidation. For many years naval designers had gone on increasing the length of vessels in proportion to their width, in the hope that with the same cross-section, greater carrying capacity could be attained without decreasing the speed or much increasing the driving power.

The steamship City of Rome,† for instance, is 600 feet long over all, with an extreme breadth of 52 feet 3 inches, and depth of hold of 37 feet. Her midship cross-section on 26-feet draught would be about 1 300 square feet. She is estimated to weigh 8 000 tons, with a total displacement on 26-feet draught of 13 500 tons, or carrying capacity of 5 500 tons. The America has 459 feet extreme length, and breadth of 51 feet 1 inch, and depth amidships of 38 feet 6 inches. On 26-feet draught her cross-section will be some 27 square feet less than that of the City of Rome—or nearly equal to it—while her total tonnage is 8 830, and carrying capacity 2 830 tons. The indicated horse-power of the former vessel is over 14 000, but, as is well-known, the power of her engines and boilers had to be very much increased over the original

* This information has been obtained from Mr. Alex. MacLennan, Superintending Engineer of the National Steamship Co.; and Mr. Dover, Chief Engineer of the steamship America.

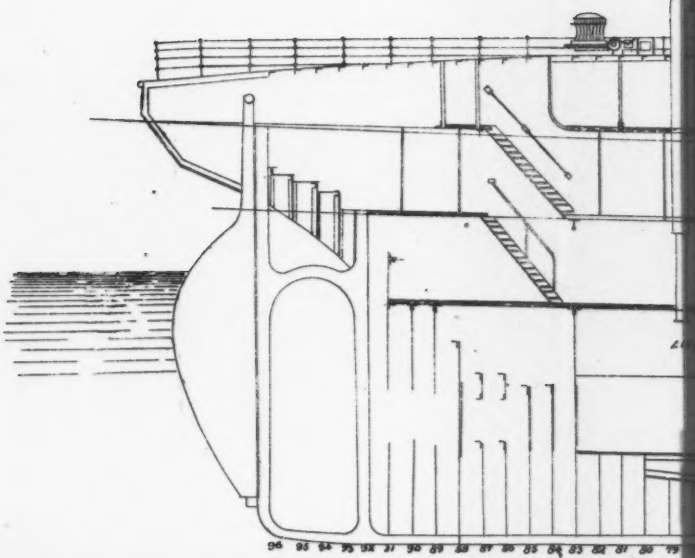
† The steamship City of Rome is described according to the original designs in the Proceedings of the Institution of Mechanical Engineers for 1880, p. 336 *et seq.*

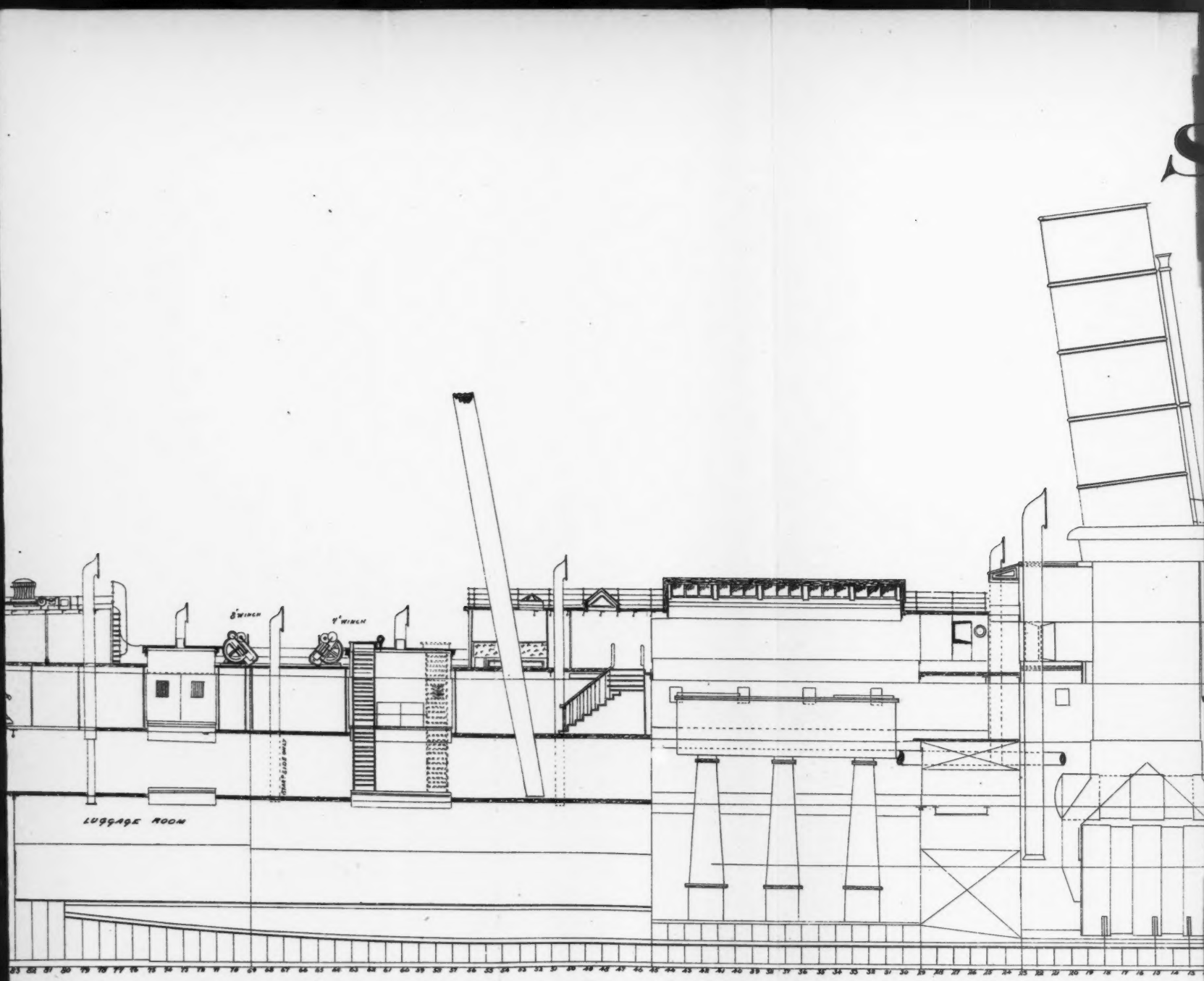
peller is four-bladed, 22 feet in diameter. The leading side has a regular pitch of 29 feet; the following side a pitch varying from 24 to 34 feet. The blades are of manganese bronze; the boss is of steel. The weight of the former is about 15 tons; of the latter, about 9 tons with the bolts. The total surface of the four blades is 164 square feet.

The vessel is designed to carry 670 cabin and 300 aft passengers. The state-rooms are very spacious, and each one, as well as the larger between-deck spaces, is connected to ventilating tubes which terminate in the chimneys, and secure a thorough renewal of fresh air. A complete system of drainage from the cabins, and decks and bilges in the several compartments, is made by piping and pumps, worked by the engines. The ship is lighted throughout by electricity, the Swan arc light being used. A special feature in the design is the saloon, which occupies the full breadth of the ship, and has a large central space rising through the upper deck. This is covered by a double dome, the interior of painted glass, the exterior of iron, with electric lamps between, which give a brilliant illumination. A gallery forms a music and conversation room at one end. The decorative work has been carried out with great taste, and the whole design reflects great credit on the builders.

The following plates are appended:

XXVII.	Steamship America.	—	Longitudinal Section.
XXVIII.	"	"	Plans of Main and Bridge Decks.
XXIX.	"	"	Plans of Upper and Lower Decks.
XXX.	"	"	Sections at Frames 19, 22, 29, 45.
XXXI.	"	"	Midship Section.
XXXII.	"	"	Propeller.
XXXIII.	"	"	Plan and Section showing engines.




8" WINCH
4" WINCH
LUGGAGE ROOM

S.S. America.

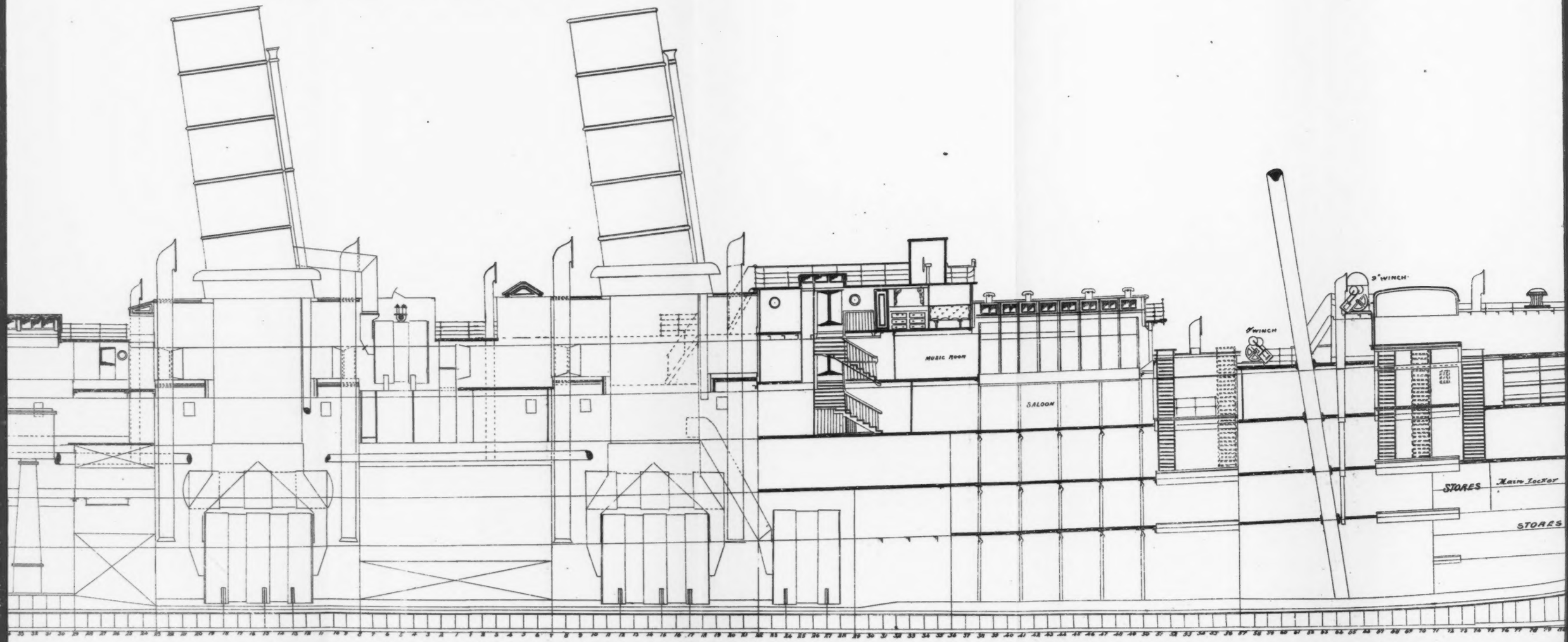


PLATE XXVII
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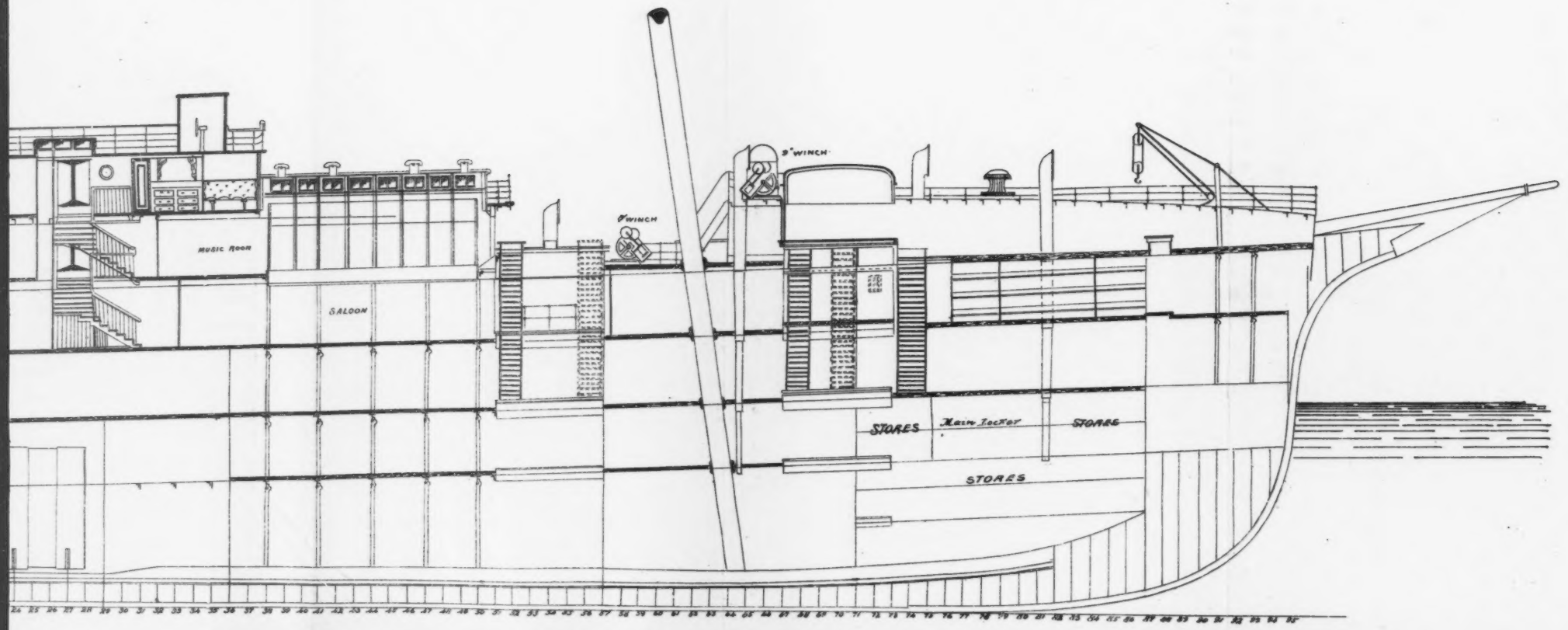
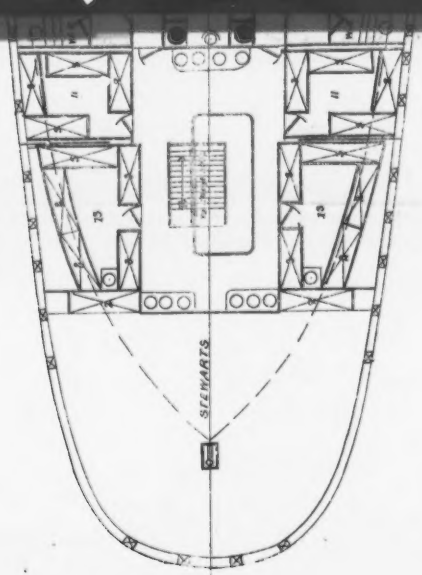
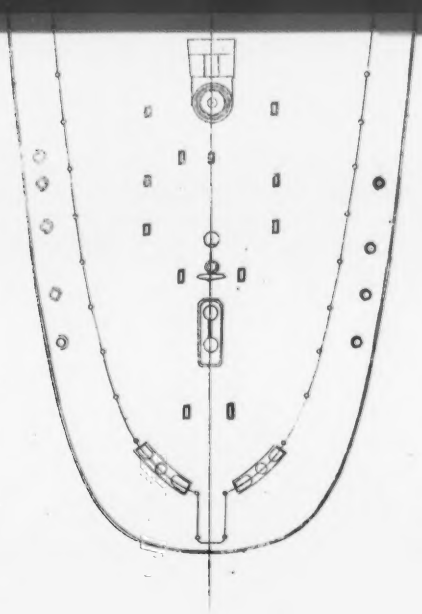
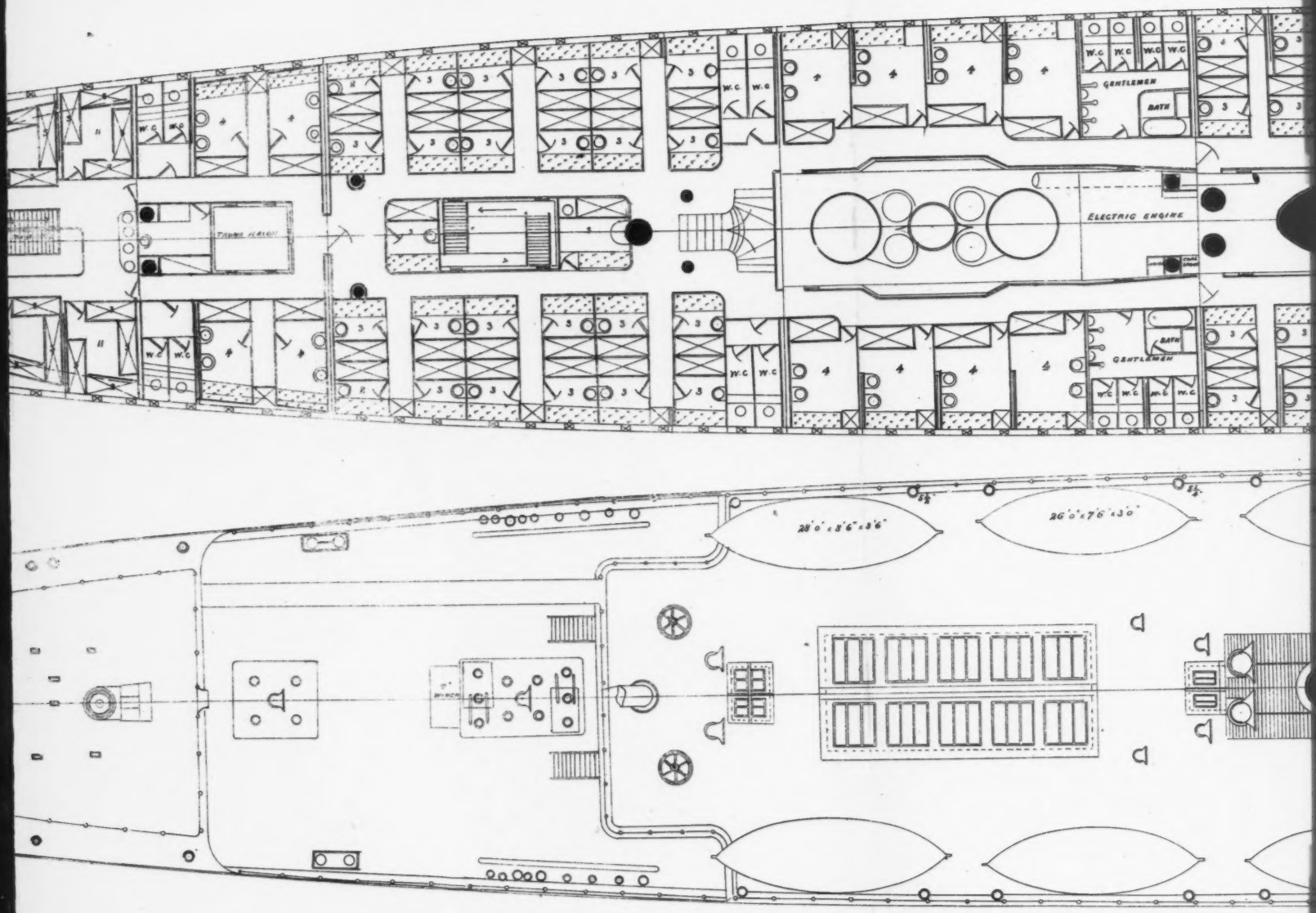
GORDON ON
STEAMSHIP AMERICA

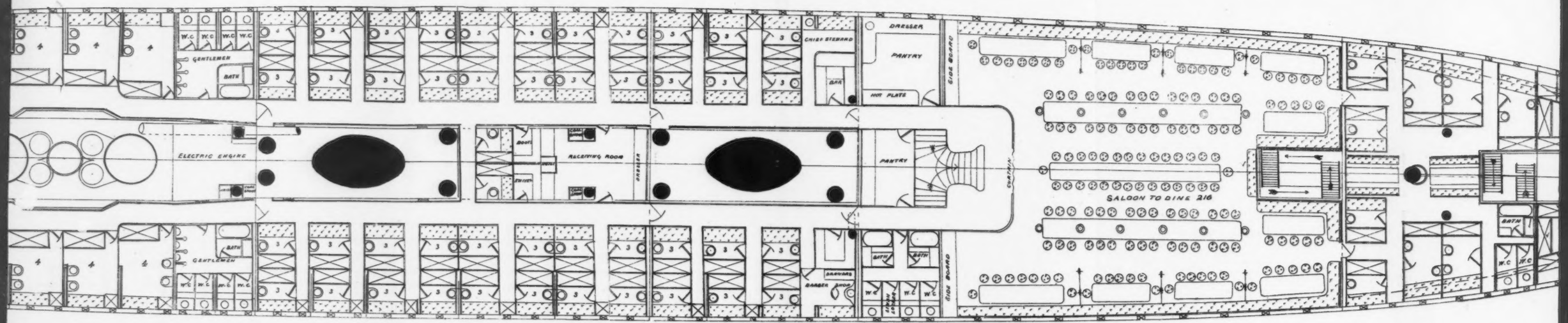


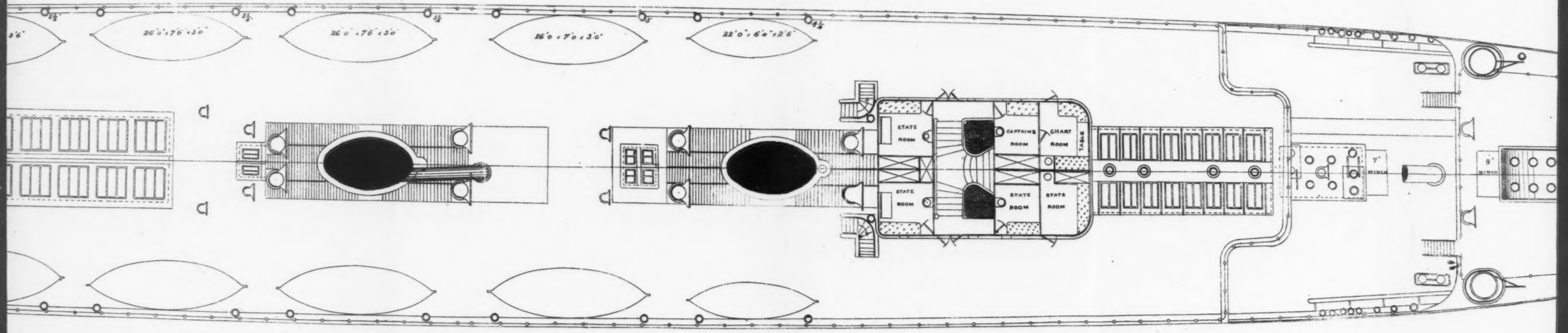

STEWARTS




W.C.
GENTLEMEN
BATH
ELECTRIC ENGINE
28'0" x 8'6" x 8'6"
26'0" x 7'6" x 3'0"

Main Deck





Bridge Deck.

PLATE XXVIII
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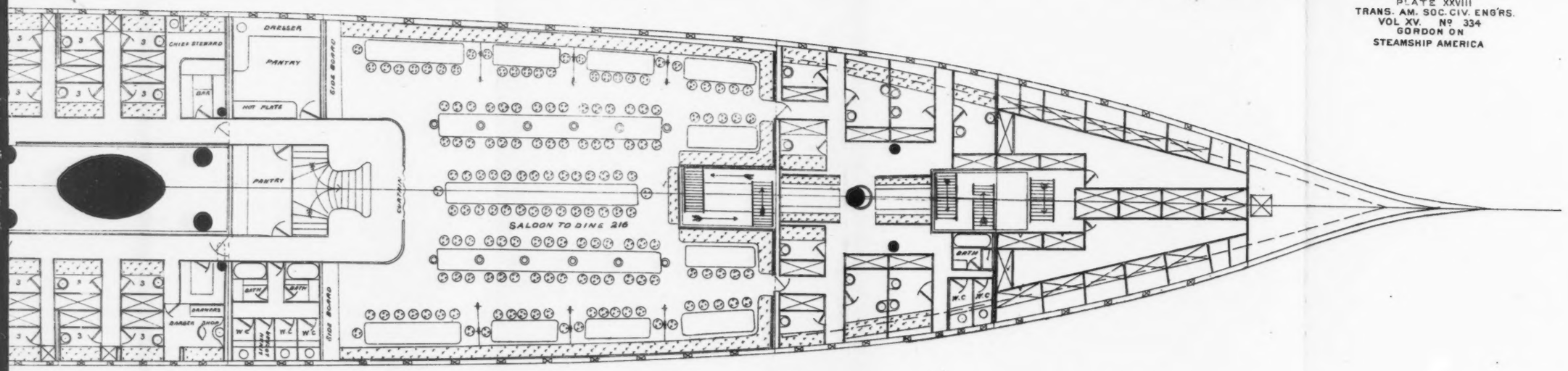
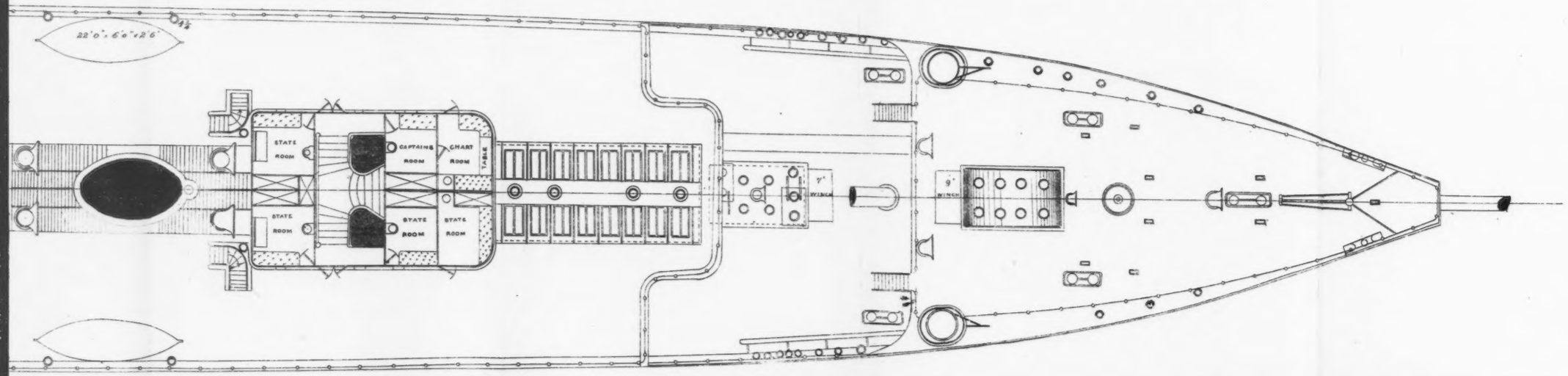
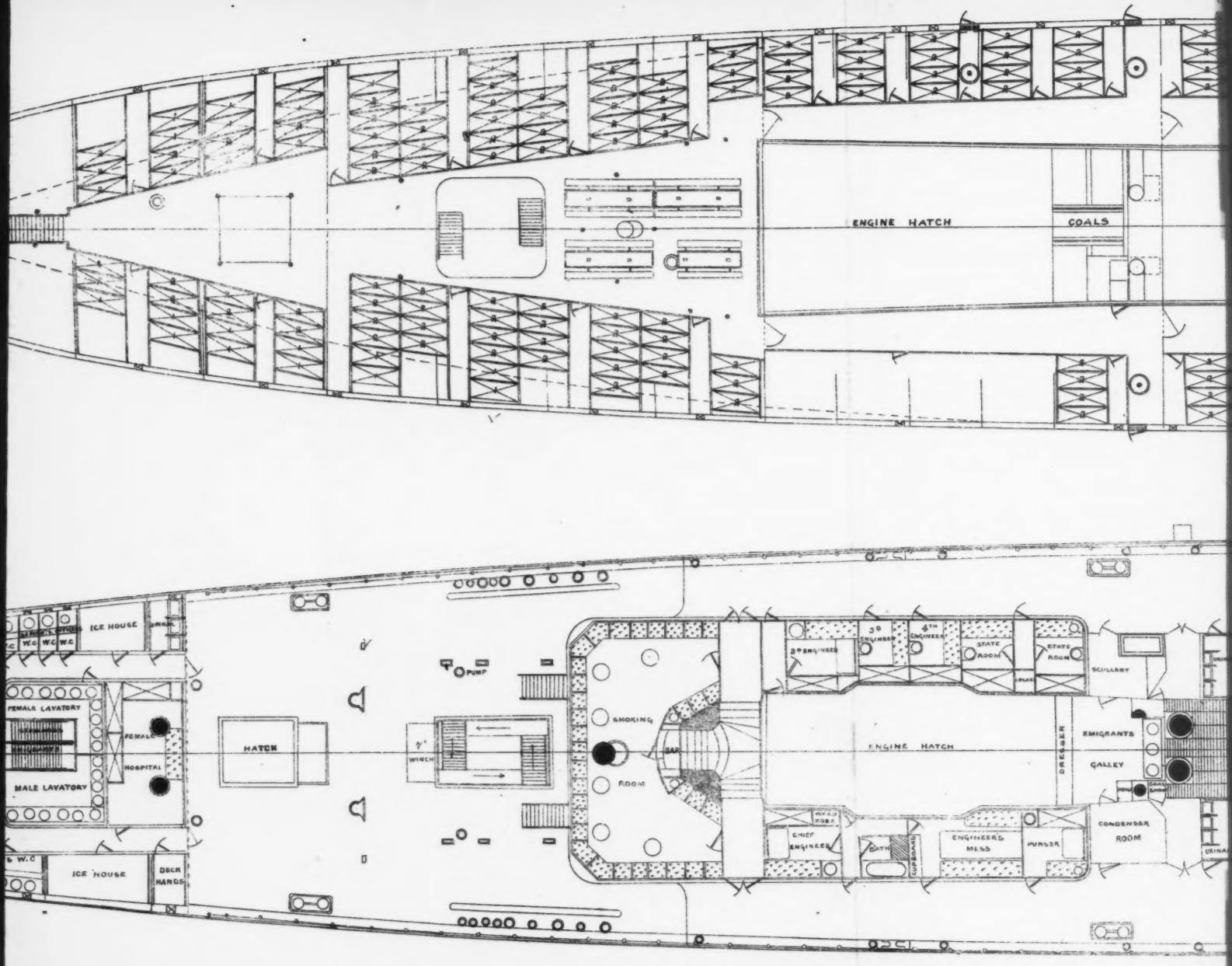
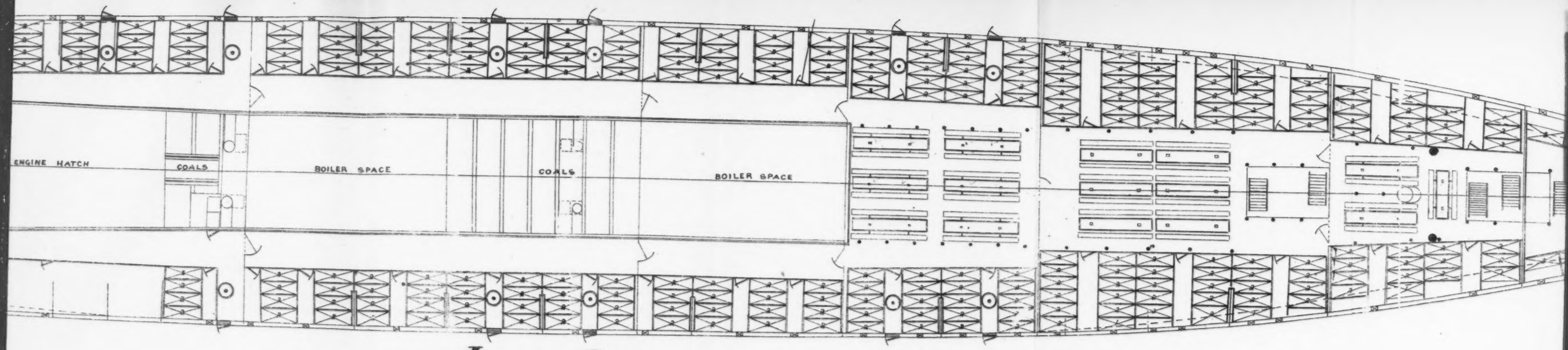
STEAMSHIP AMERICA



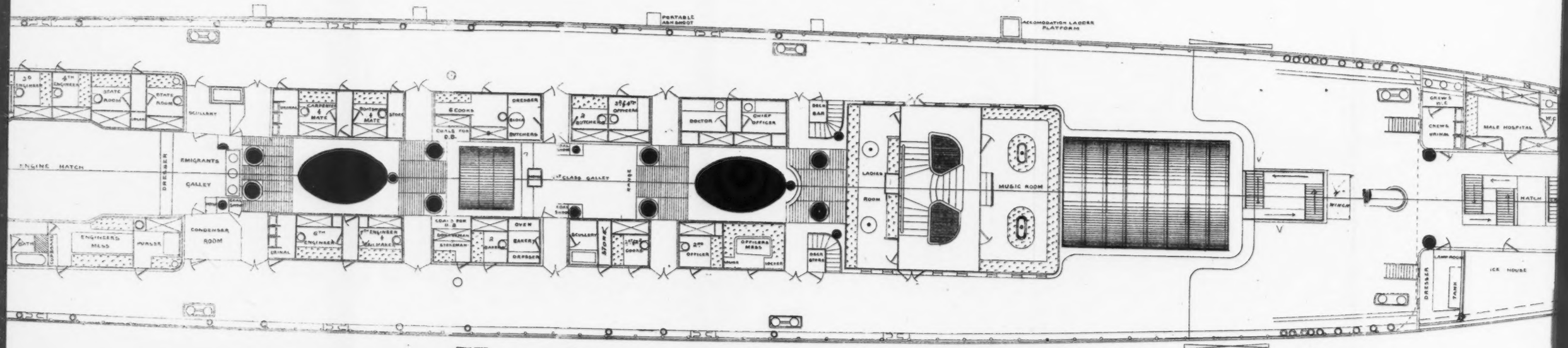


ICE HOUSE
STEERAGE W.C
W.C
W.C
W.C
FEMALE LAVATORY
STEERING GEAR
HAND
STEAM
MALE LAVATORY
HOSPITAL
EMIGRANTS W.C
ICE HOUSE


ENGINE HATCH
COALS
ICE HOUSE
W.C
W.C
W.C
FEMALE LAVATORY
MALE LAVATORY
FEMALE
HOSPITAL
HATCH
PUMP
WINCH
SMOKING
ROOM
BAR
2ND ENGINEER
3RD ENGINEER
4TH ENGINEER
STATE ROOM
STATE ROOM
SCULLERY
ENGINE HATCH
DRESSER
EMIGRANTS
GALLEY
CHIEF ENGINEER
BATH
ENGINEERS MESS
PURSER
CONDENSER ROOM
6 W.C
ICE HOUSE
DECK HANDS



Lower Deck.



Upper Deck

PLATE XXIX
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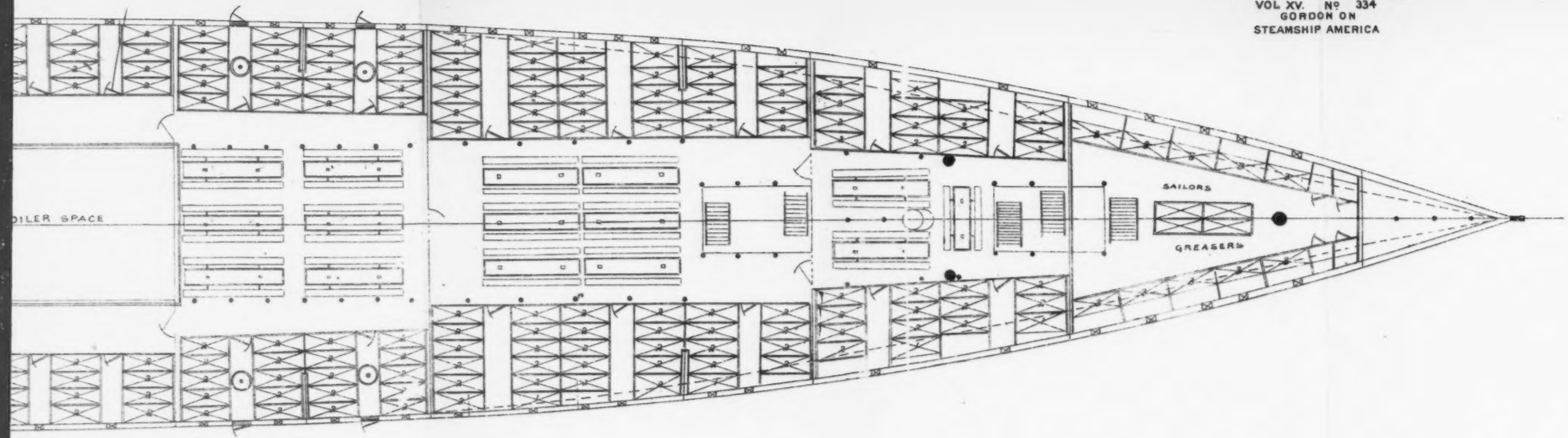
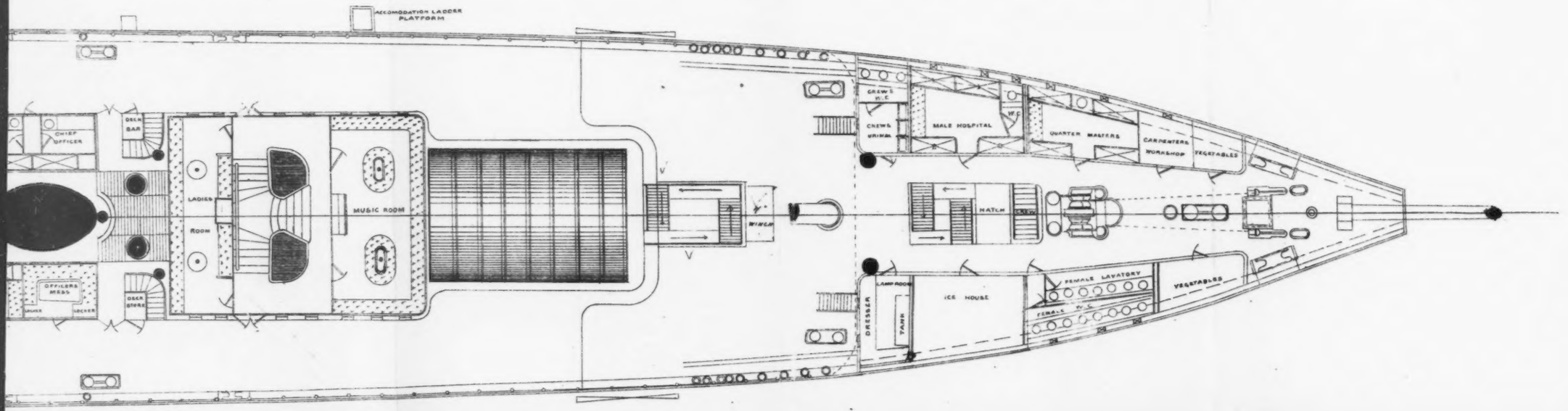
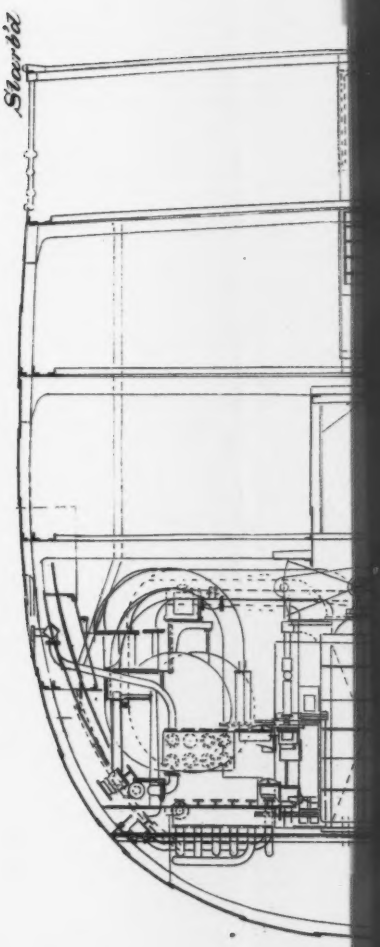
GORDON ON
STEAMSHIP AMERICA

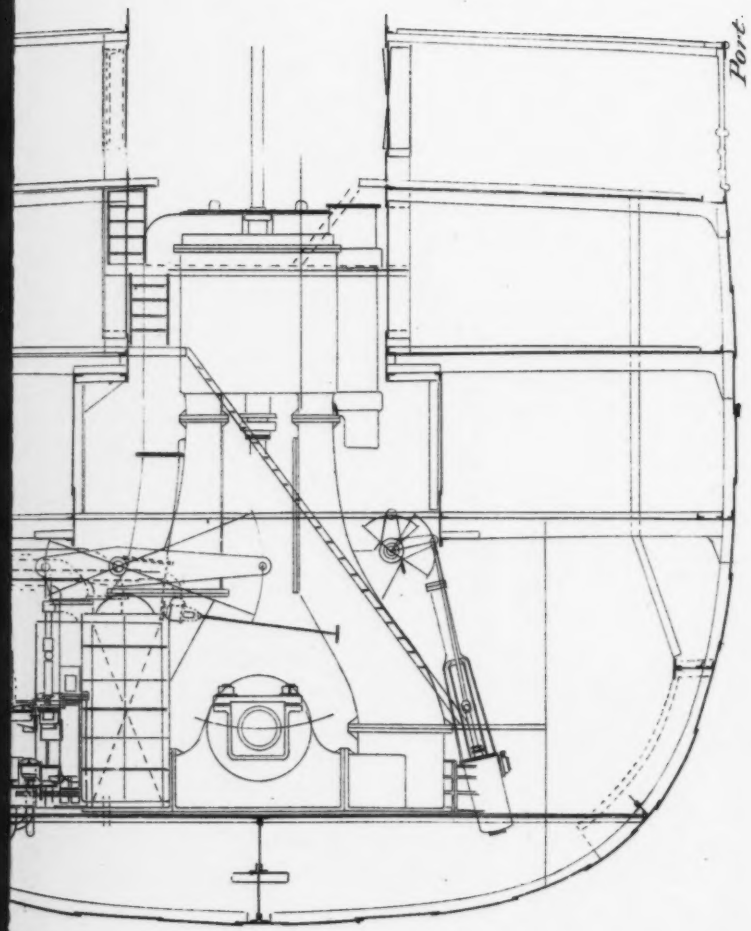




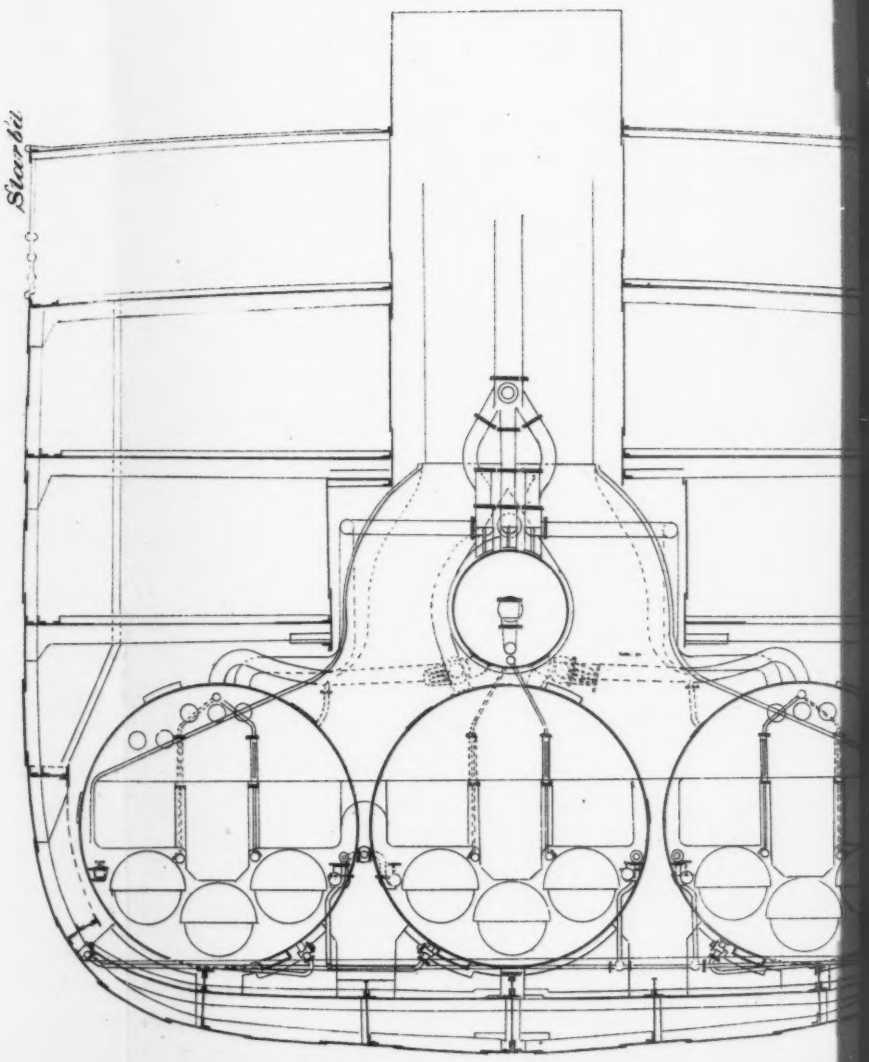
Section o



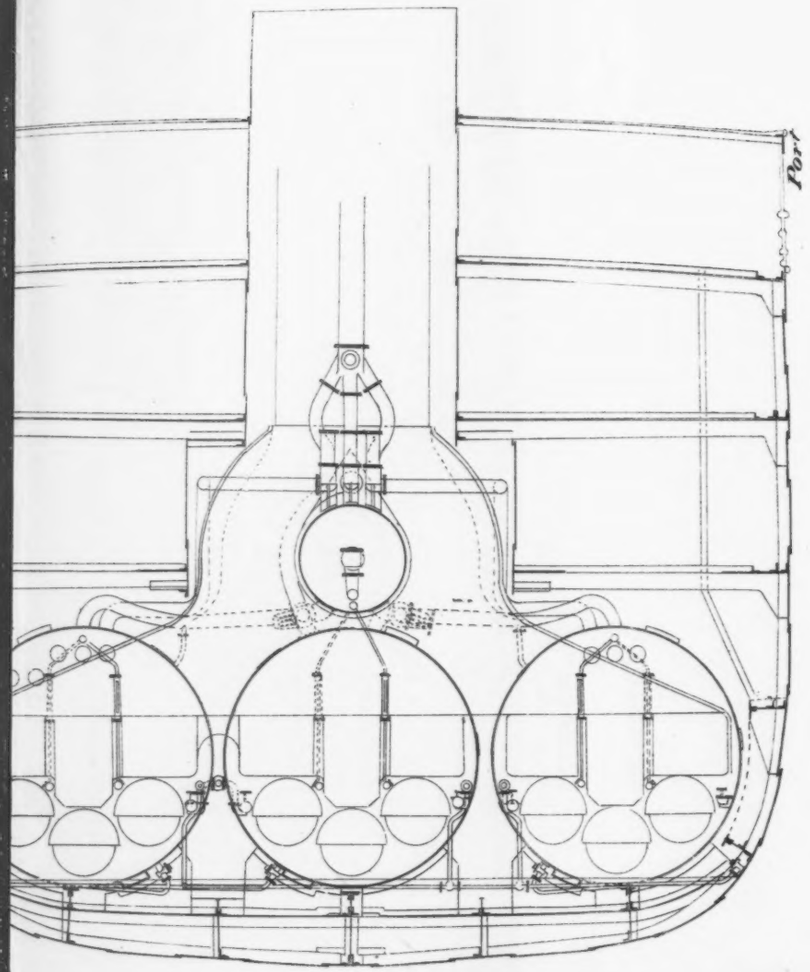
tion at Frame № 29 looking aft.



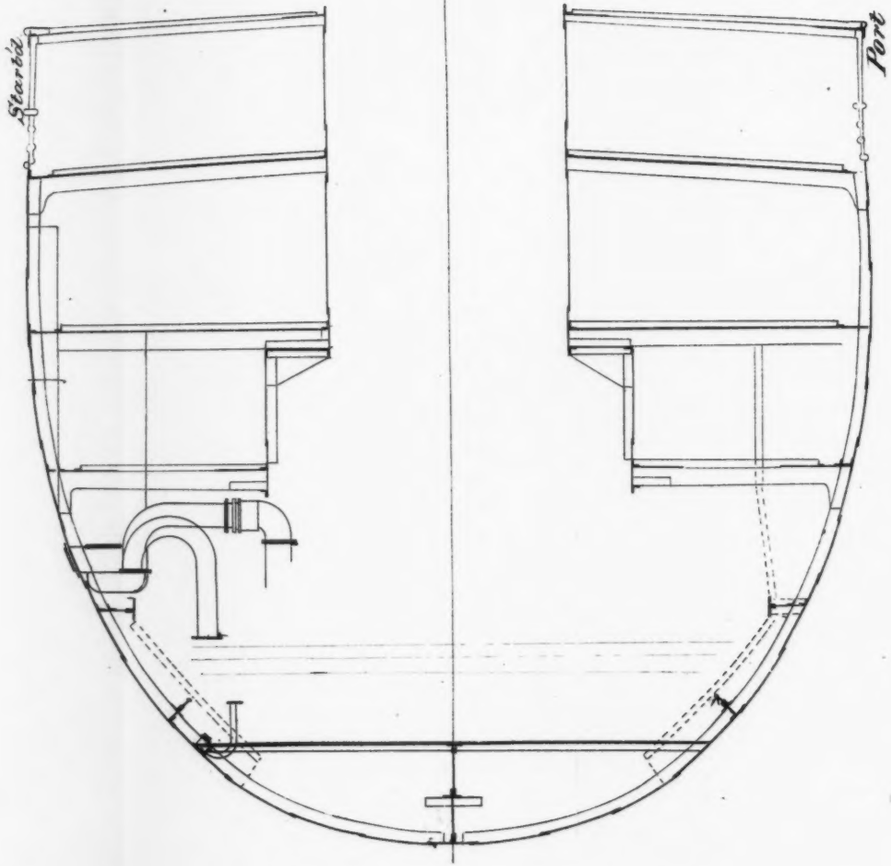
Section at Frame № 19, fore body; lookin



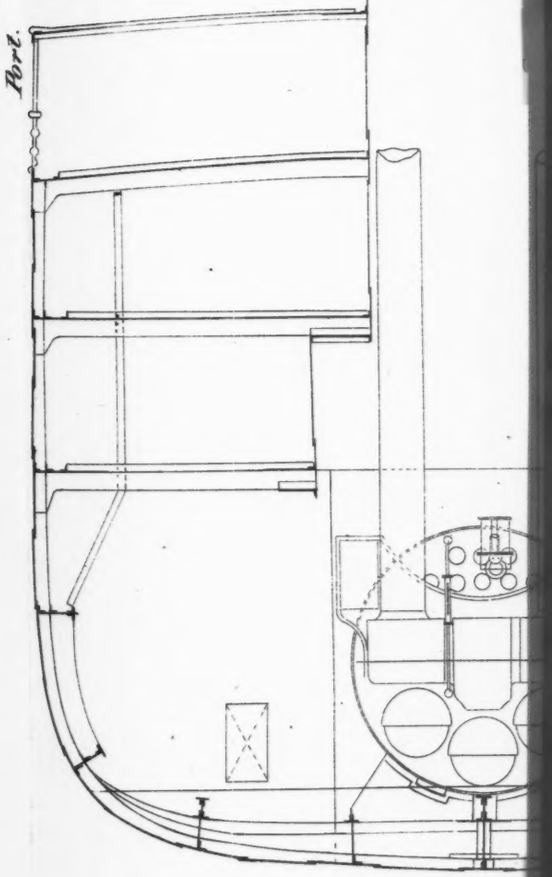
ection at Frame №19, fore body; looking aft.



Section at Frame №45 looking aft.



Section at Frame №22, fore b



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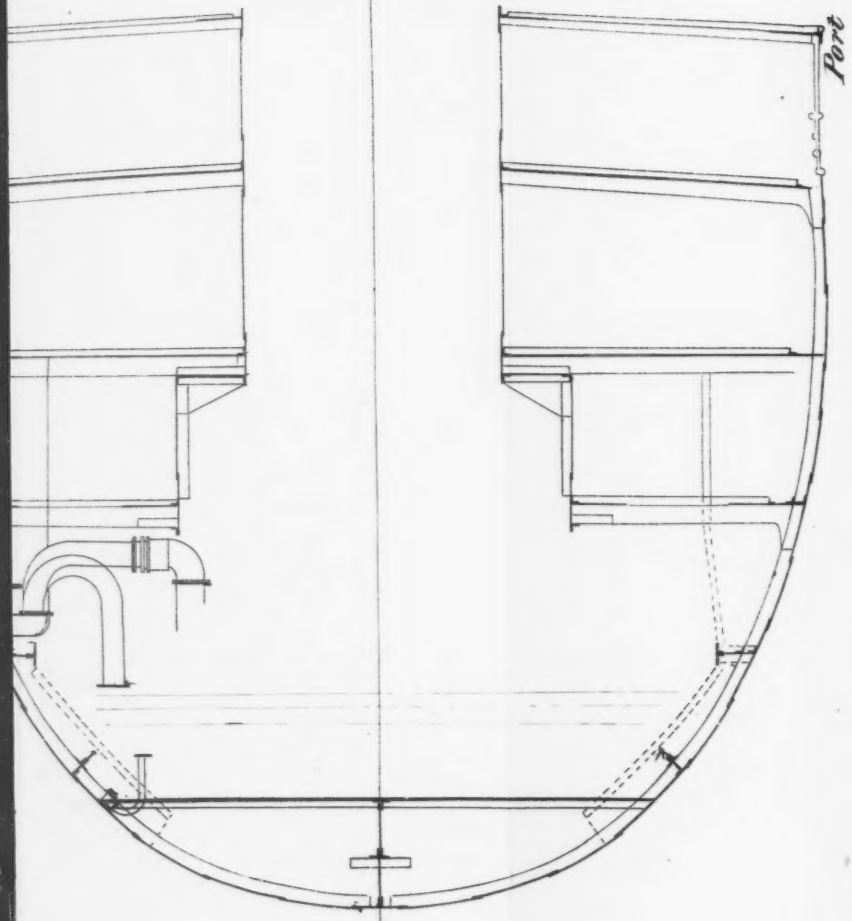
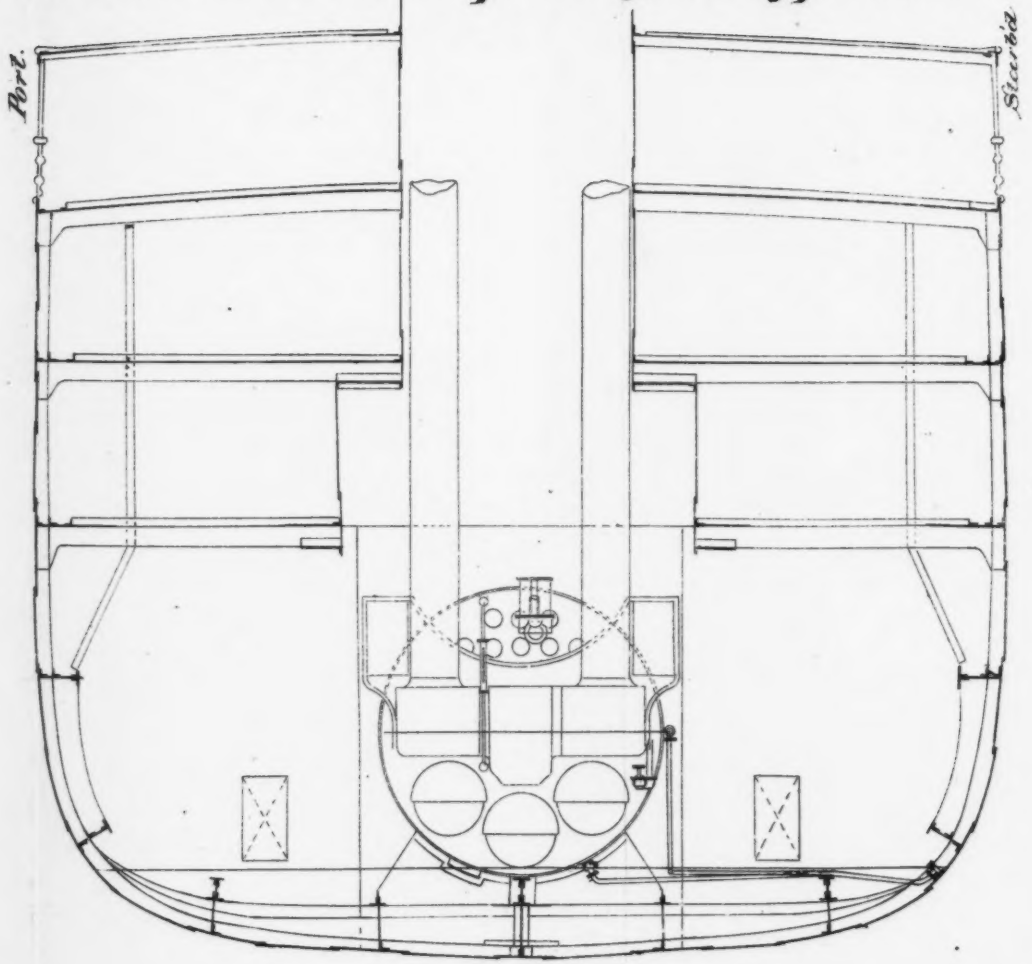
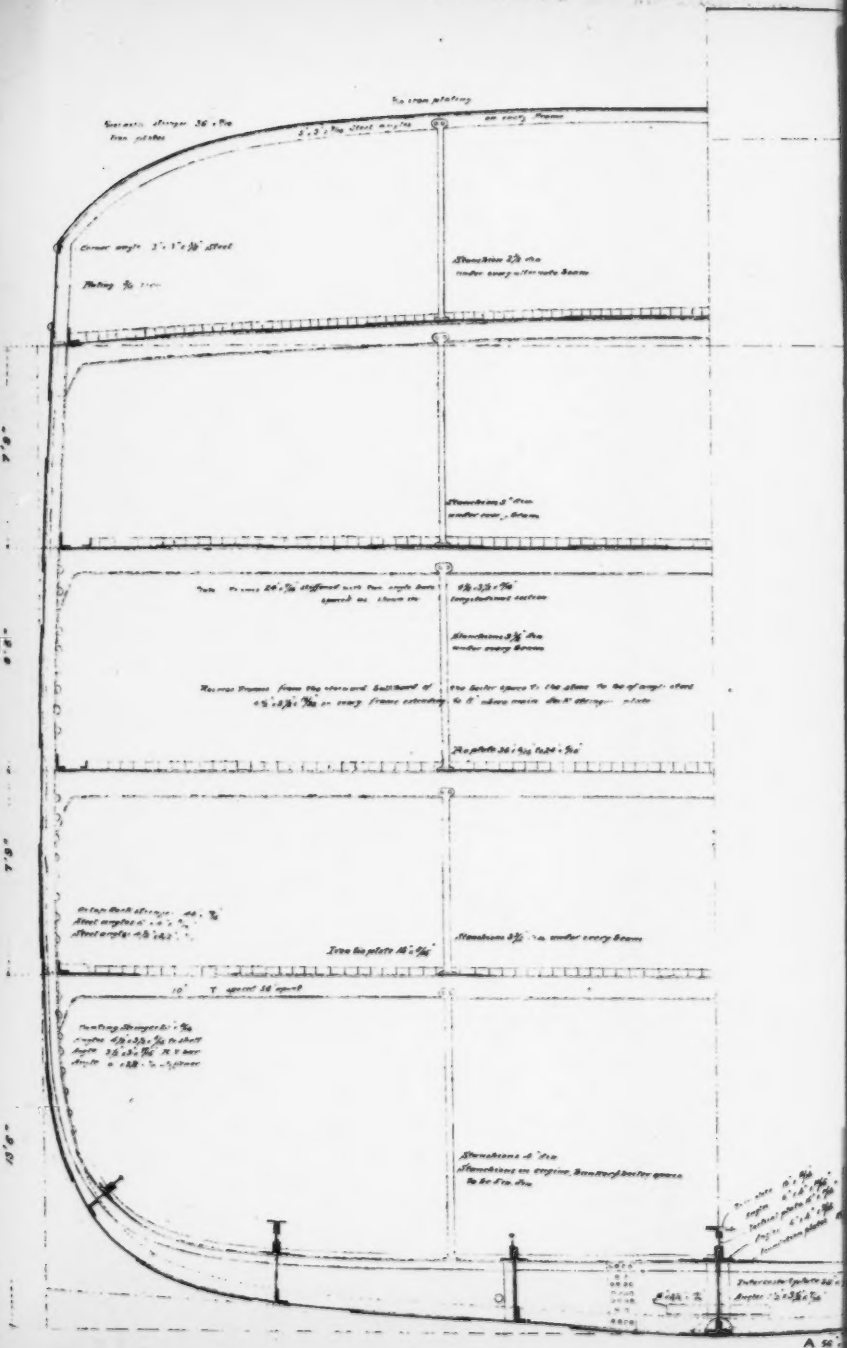
Section at Frame Nº 45 looking aft.



Section at Frame Nº 22, fore body, looking forward.



Midship Section o



Section of S.S. America.

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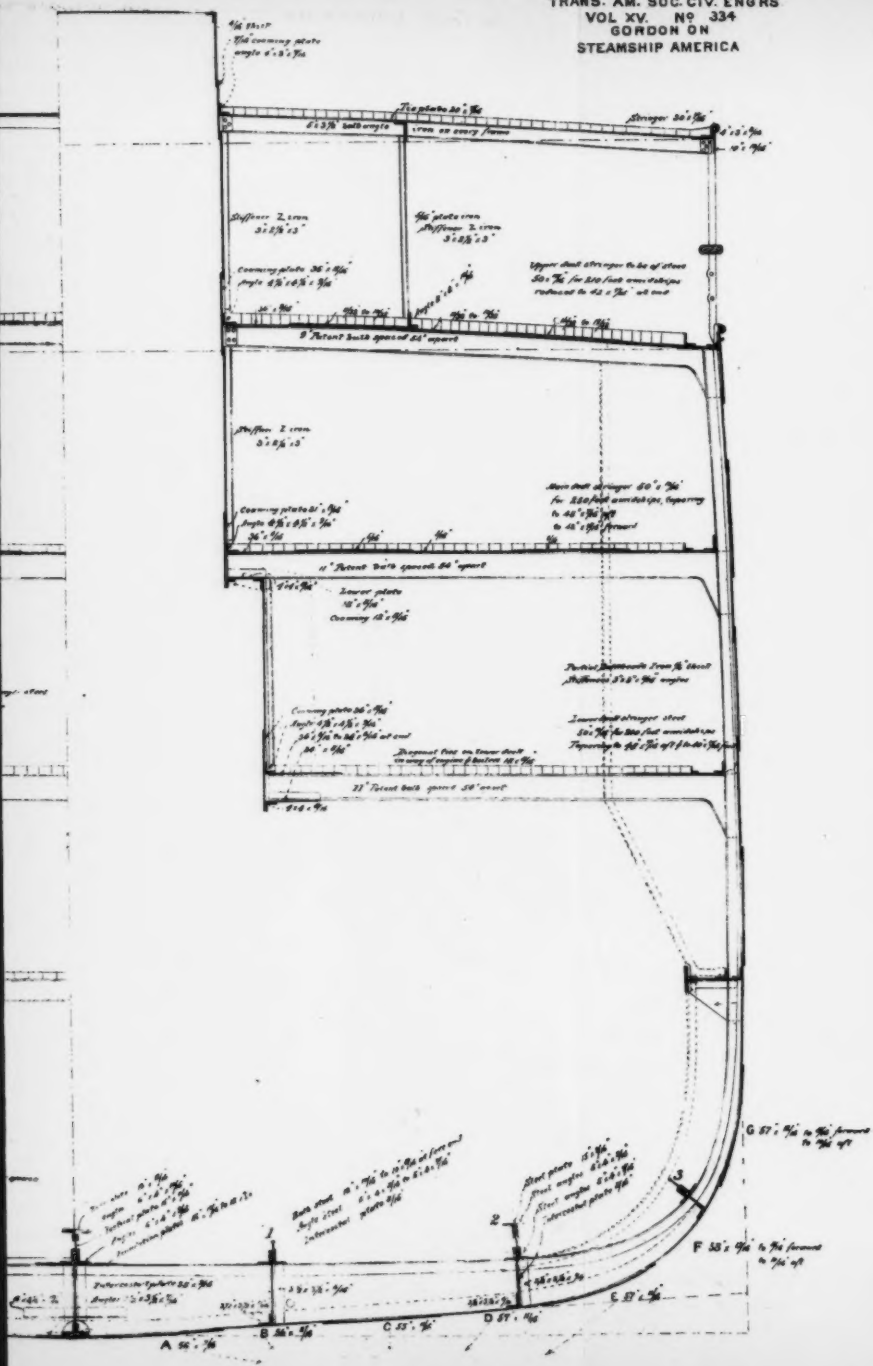

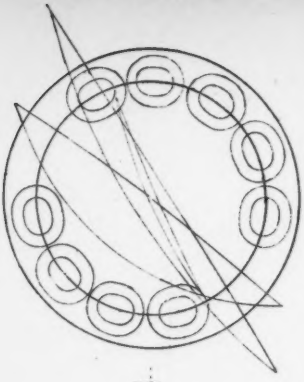

S.S. America

Size of Propeller 22' over Blades
Steppage " " 18' 0"
Elevation guides on leading wire 20'
Bearing " " following " 24' 34'
Rocker " " 25'.

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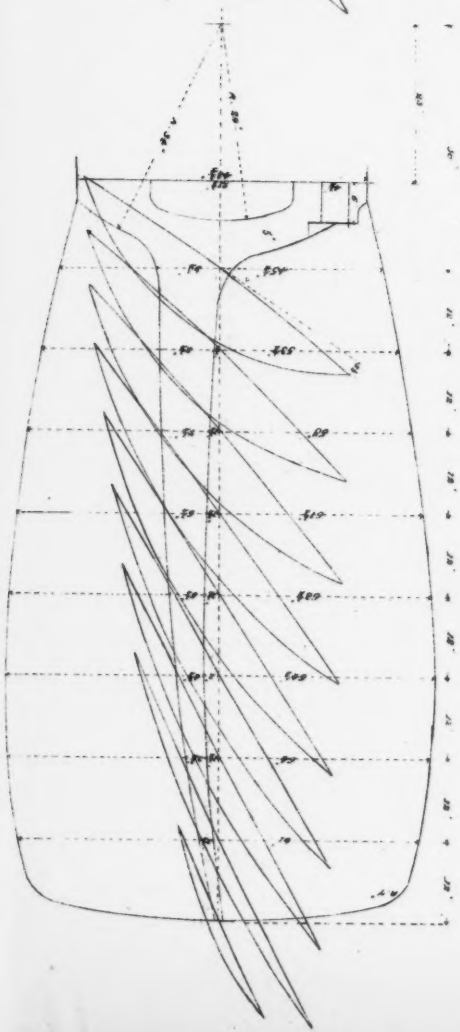

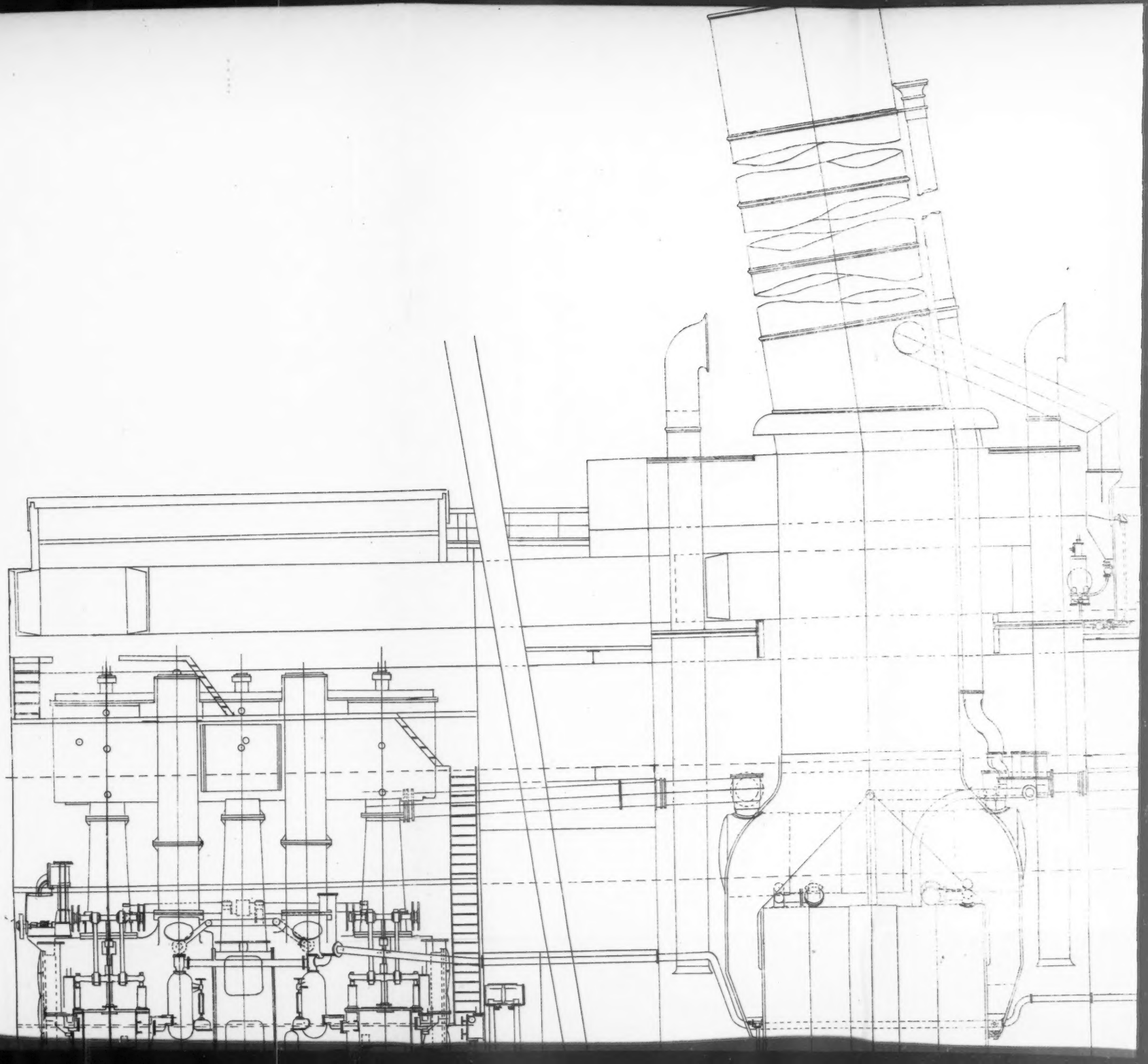

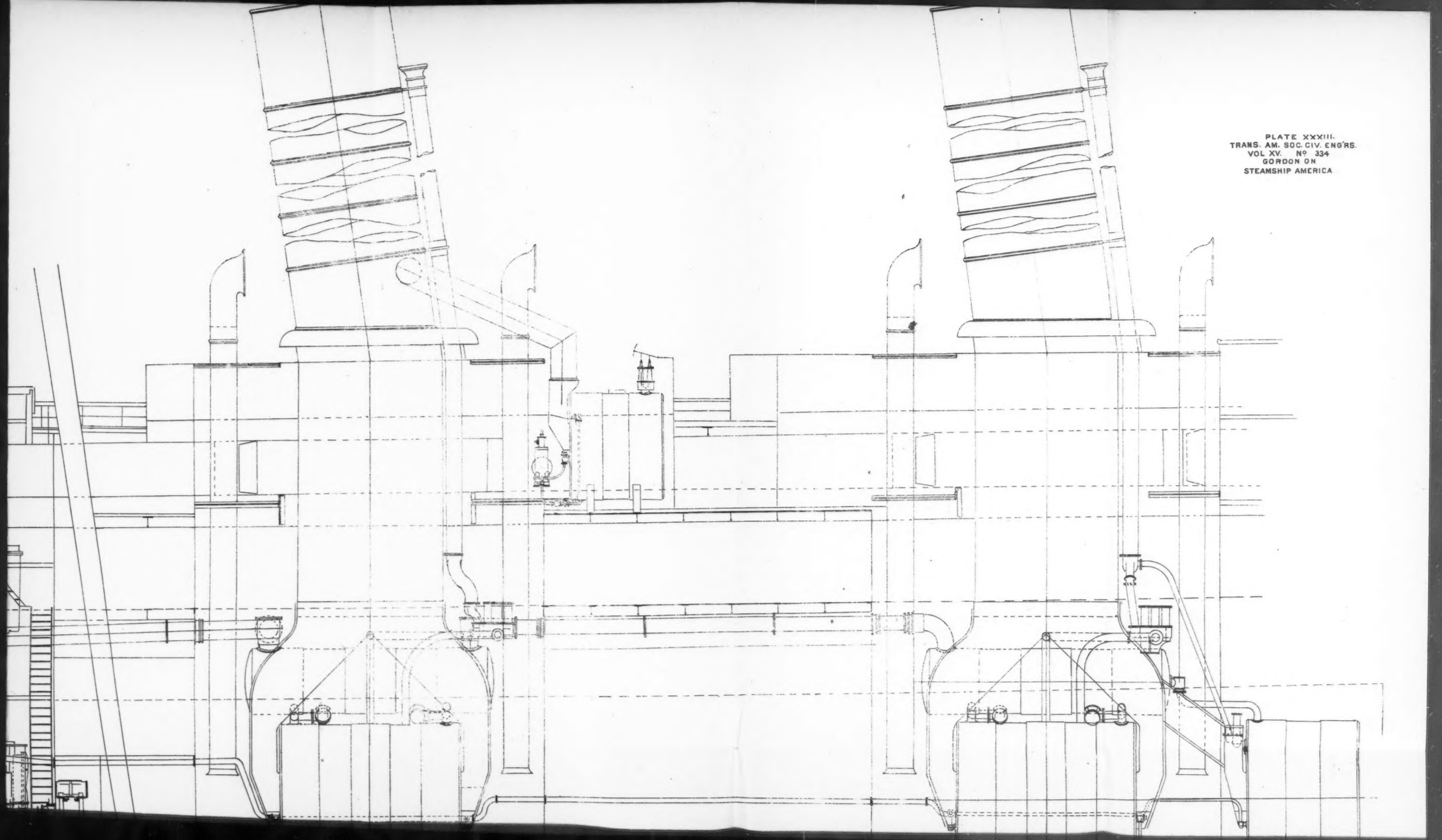
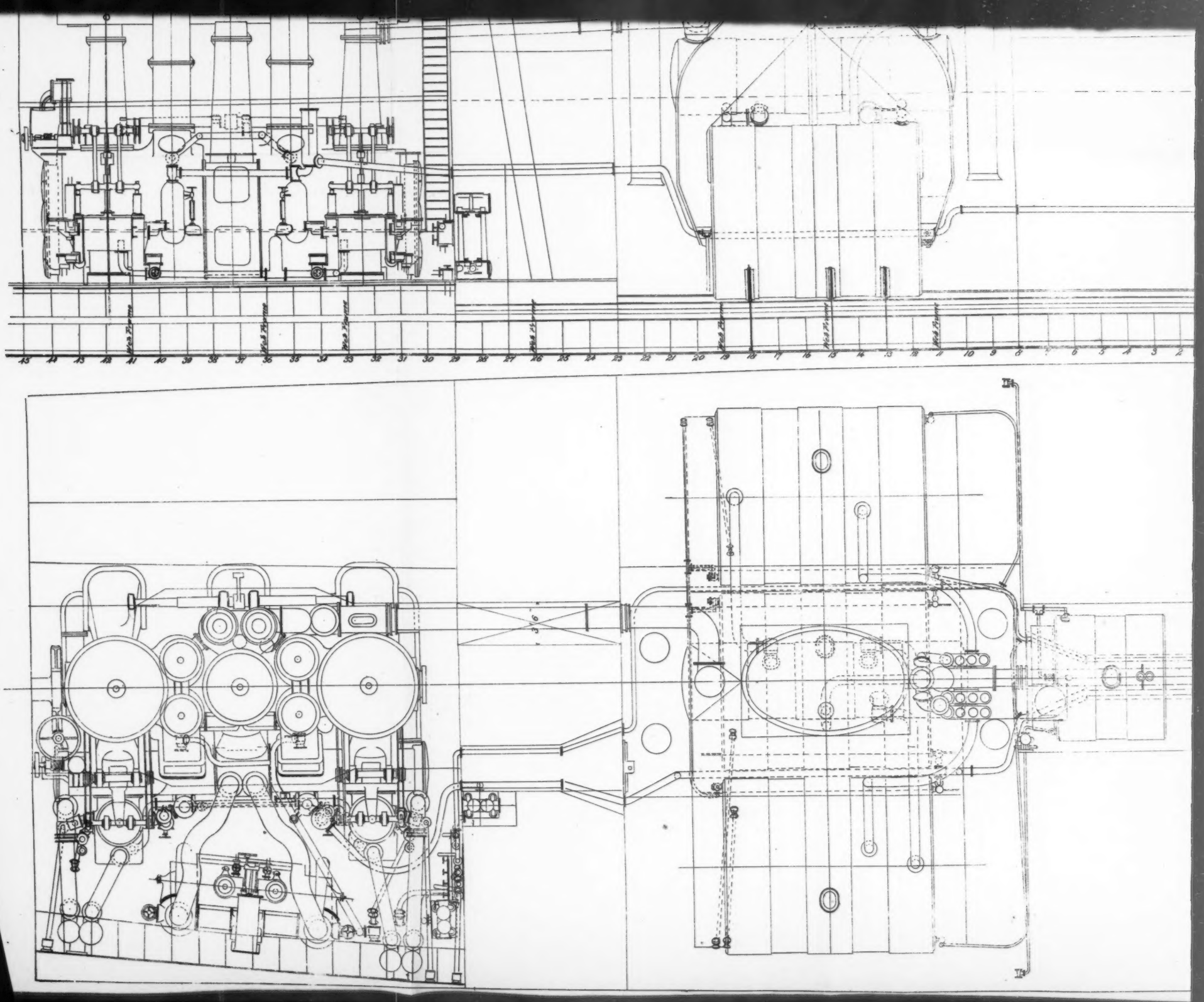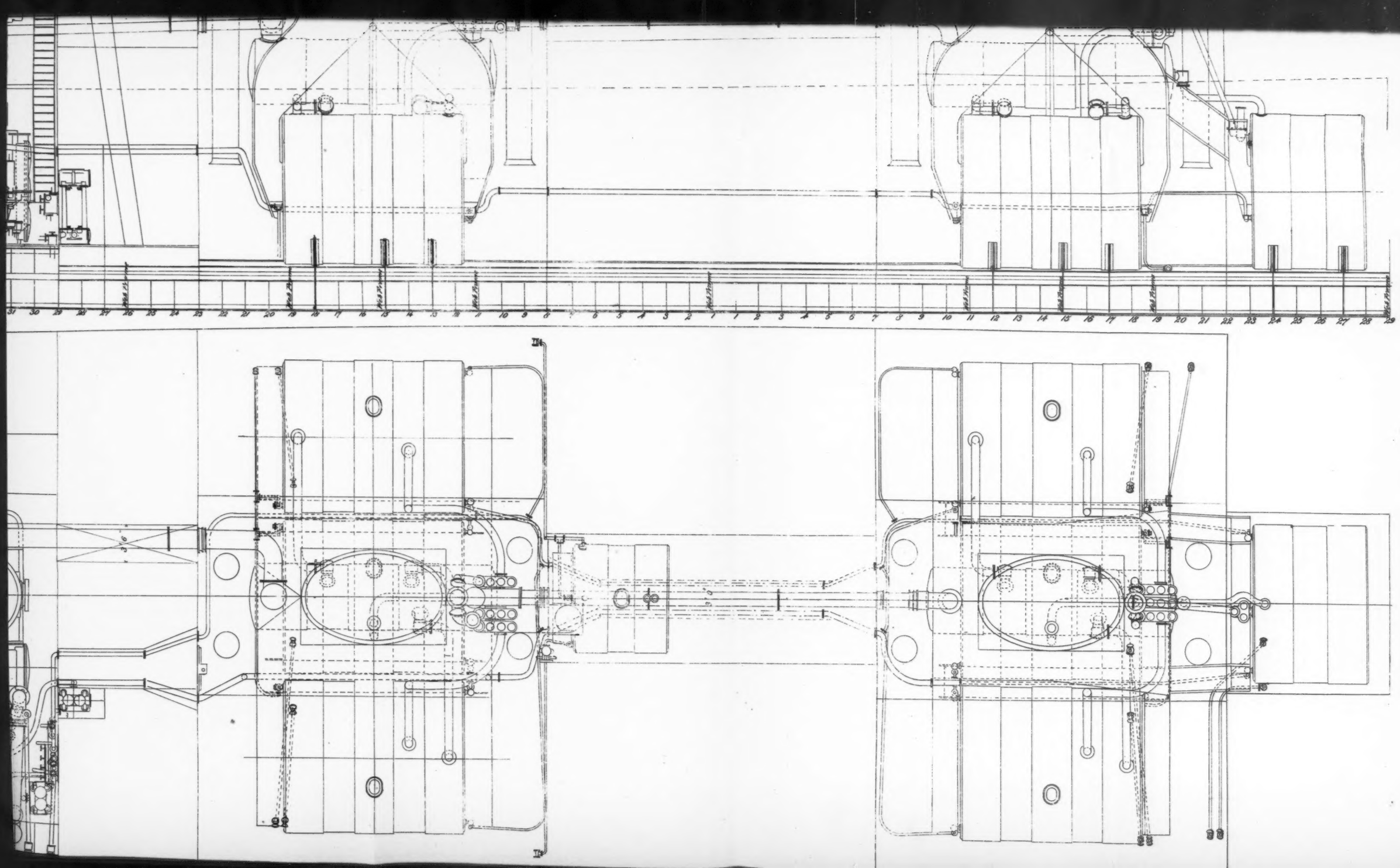
PLATE XXXIII.
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